Quick Start

Allen-Bradley

SMC™-50 Solid-State Smart Motor Controller

Bulletin 150

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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Introduction

SMC-50

This Quick Start guide provides you with the basic information required to install, start up, and program your SMC™-50 Soft Starter.

The SMC-50 is a reduced voltage soft starter that utilizes a state-of-the-art microprocessor- based control module and solid-state (without an integral bypass contactor) power structure. Using six back-to-back SCRs (two per phase), the SMC-50 provides controlled acceleration, operation/run, and deceleration of standard asynchronous induction motors.

The information provided in this Quick Start guide does not replace the user manual, which can be ordered or downloaded by visiting www.ab.com/literature. The Quick Start guide assumes the installer is a qualified person with previous experience and basic understanding of electrical terminology, configuration procedures, required equipment, and safety precautions.

For safety of maintenance personnel as well as others who might be exposed to electrical hazards associated with maintenance activities, follow all local safety related work practices (e.g., NFPA 70E, Part II in the United States). Maintenance personnel must be trained in the safety practices, procedures, and requirements that pertain to their respective job assignments.

For detailed SMC-50 information, including setup, programming, precautions, and application considerations, see the following:

For Documentation	SMC-50 User Manual 150-UM011	www.ab.com/literature
	SMC-50 Selection Guide 150-SG010	www.ab.com/literature
For Technical Support	E-mail Support	raictechsupport@ra.rockwell.com
	Telephone Support	440-646-5800, option 1, option 1, and direct dial code 804

General Precautions

WARNING:

- Only personnel familiar with the controller and associated machinery should plan or implement the installation, startup, and subsequent maintenance of the system. Failure to do this may result in personal injury and/or equipment damage.
- Hazardous voltage is present in the motor circuit even when the SMC-50 controller is off. To avoid shock hazard, disconnect the main power before working on the controller, motor, and control devices such as Start-Stop push buttons. Procedures that require parts of the equipment to be energized during troubleshooting, testing, etc., must be performed by properly qualified personnel, using appropriate local safety work practices and precautionary measures.
- Failure of solid-state power switching components can cause overheating due to a single-phase condition in the motor. To prevent injury or equipment damage, the use of an isolation contactor or shunt trip type circuit breaker on the line side of the SMC is recommended. This device should be capable of interrupting the motor's lock rotor current.
- Hazardous voltages that can cause shock, burn, or death are present on L1, L2, L3,T1, T2, and T3. Power terminal covers for units rated 90…180 Amps can be installed to prevent inadvertent contact with terminals. Disconnect the main power before servicing the motor controller, motor, or associated wiring.

ATTENTION:

- Static control precautions are required when installing, testing, servicing, or repairing the assembly. The controller contains electrostatic discharge sensitive parts and assemblies. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, See applicable ESD protection handbooks.
- Stopping modes, such as braking, are not intended to be used as an emergency stop. The user is responsible for determining which stopping mode is best suited to the application. See the applicable standards for emergency stop requirements.
- Pump and linear deceleration stopping modes may cause motor heating. Depending upon the mechanical dynamics of the system, select the lowest stopping time setting that will satisfactorily stop the motor.
- Slow speed running is not intended for continuous operation. This is due to reduced motor cooling.
- Two peripheral devices can be connected to the direct programming interface (DPI) port located in the control module. The maximum output current through the DPI port is 560 mA.

  NOTE: A HIM located in the control module HIM port/bezel (See Figure 12) also draws power from the DPI port.
- Disconnect the controller from the power source when installing or inspecting protective modules. The protective module should be inspected periodically for damage or discoloration. Replace module if it is damaged or the clear sealant or MOV are discolored.

ATTENTION:

- The controller must be correctly applied and installed. If applied or installed incorrectly, damage to the components or the reduction in product life may occur. The system may malfunction if the following wiring or application errors occur: undersizing the motor, using an improperly sized controller, using an incorrect or inadequate AC supply, excessive ambient temperatures, or power quality.
- The Motor Overload parameter must be programmed by the installer to provide proper protection. Overload configuration must be properly coordinated with the motor.
- This product has been designed and tested as Class A equipment for electromagnetic compatibility (EMC). Use of this product in domestic environments may cause radio interference, in which case, the installer may need to employ additional mitigation methods.
- Disconnect the controller from the motor before measuring insulation resistance (IR) of the motor windings. Voltages used for insulation resistance testing can cause silicone-controlled rectifier (SCR) failure. Do not make any measurements on the controller with an insulation resistance (IR) or Megger tester.
- To protect the Smart Motor Controller (SMC) and/or motor from line voltage surges, protective modules may be placed on the line, load, or both sides of the SMC. **Do not place protective modules on the load side of the SMC** when using an inside-the-delta motor connection or with pump, linear deceleration, or braking control.
- The controller can be installed on a system with power factor correction capacitors (PFCC). **The PFCCs must only be located on the line side of the SMC**. Installing PFCCs on the load side will result in SCR damage and failure.
- The ground fault sensing feature of the SMC-50 is intended for monitoring purposes only and not as a ground fault circuit interrupter for personnel protection as defined in Article 100 of the NEC. The ground fault sensing feature has not been evaluated to UL 1053.
- After a short-circuit occurs, device functionality **must** be verified.

Installation

Mounting Requirements

All units are fan cooled. It is important to locate the controller in a position that allows air to flow vertically through the power module.

Table 1 - Mounting Requirements

Enclosure Ratings		
Standard Device Rating:		IP00 (NEMA Open Type)
Minimum Required Enclosure:		IP23 (NEMA Type 1)
Recommended Enclosure:		IP54 (NEMA Type 12) See Table 2 for minimum enclosure size
SMC Surrounding Air Ambient Temperature:		-20...+40 °C (-4...104 °F)
Orientation & Clearance		
Mounting Orientation:		Vertical ONLY
Minimum Clearance:	Horizontal	0 cm (0 in.)
	Vertical	15 cm (6 in.)

Figure 1 - SMC-50 Mounting Protection

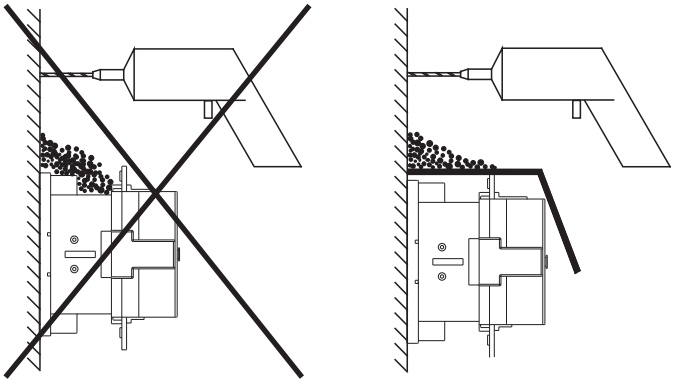


Table 2 - Minimum Enclosure Size for Short-Circuit Ratings❶

	Configuration	mm (in.)		
		Width	Height	Depth
150-SB…	Line/Wye	609.6 (24.0)	762.0 (30.0)	304.8 (12.0)
	Inside-the-Delta	762.0 (30.0)	965.2 (38.0)	355.6 (14.0)
150-SC…	All	762.0 (30.0)	965.2 (38.0)	355.6 (14.0)
150-SD…	All	914.4 (36.0)	1295.4 (51.0)	355.6 (14.0)

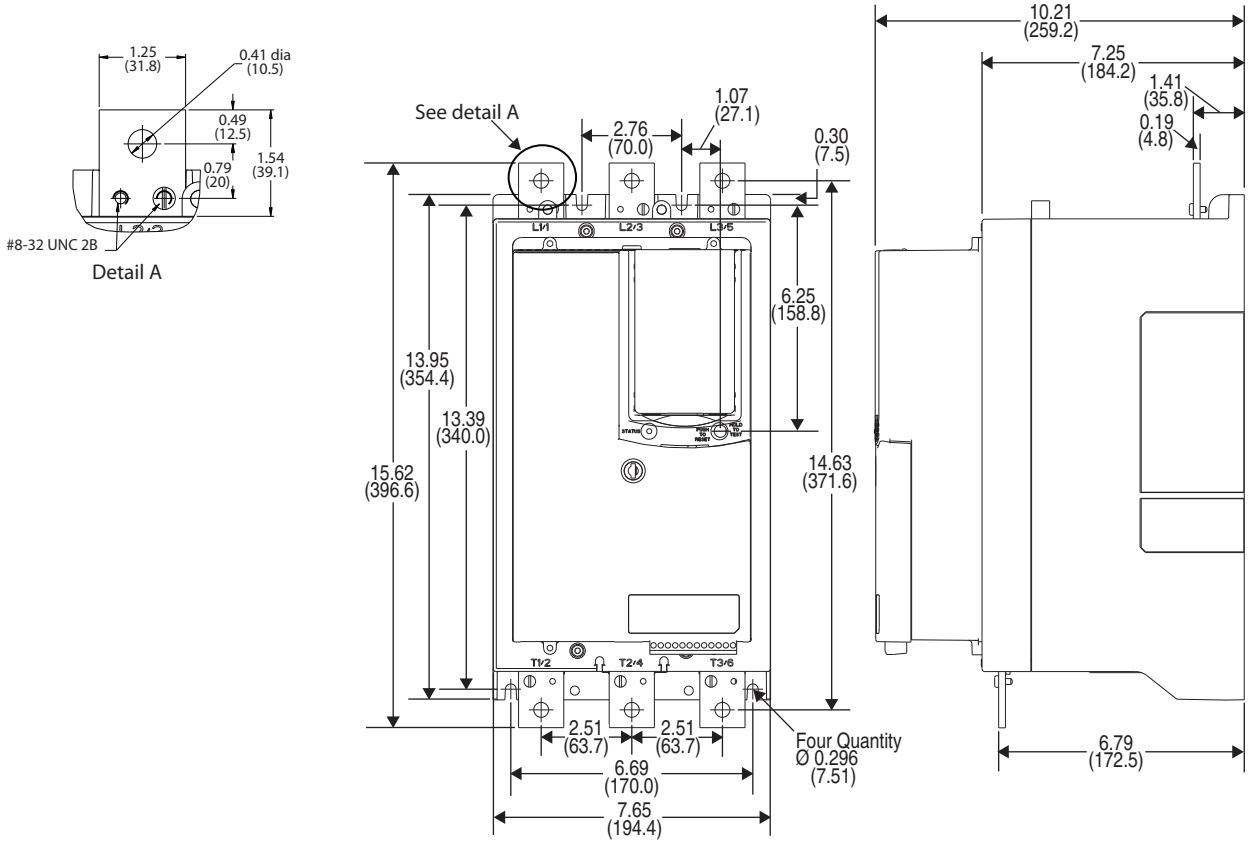
❶ Actual enclosure size is dependent on heat dissipation, duty cycle, ambient temperature, and external cooling methods.

Dimensions

NOTE: Dimensions are in inches (millimeters). All dimensions are approximate and are not intended for manufacturing purposes. Consult your local Rockwell Automation sales office or Allen-Bradley distributor for complete dimension drawings.

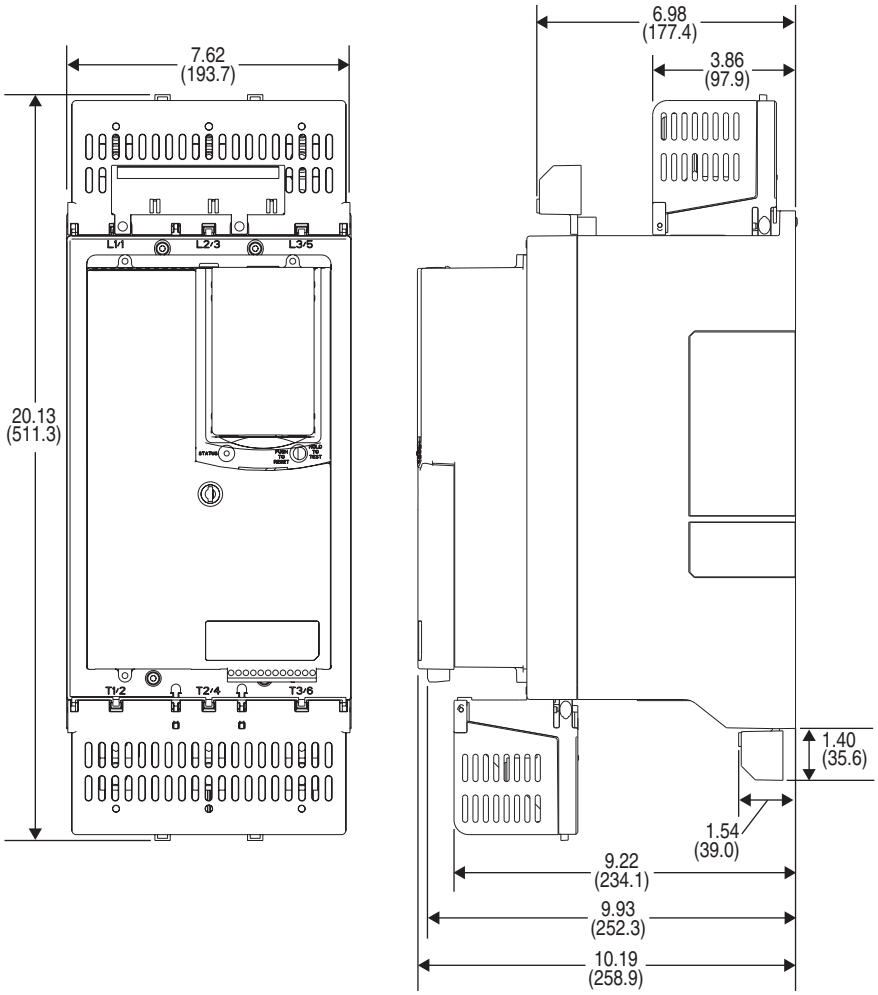
Cat. No. 150-SB… Controllers

Figure 2 - Dimensions of Cat. No. 150-SB Controller without Terminal Covers



Catalog Number	Approximate Shipping Weight
150-SB1…	15.7 kg 34.6 lb
150-SB2…	
150-SB3…	
150-SB4…	

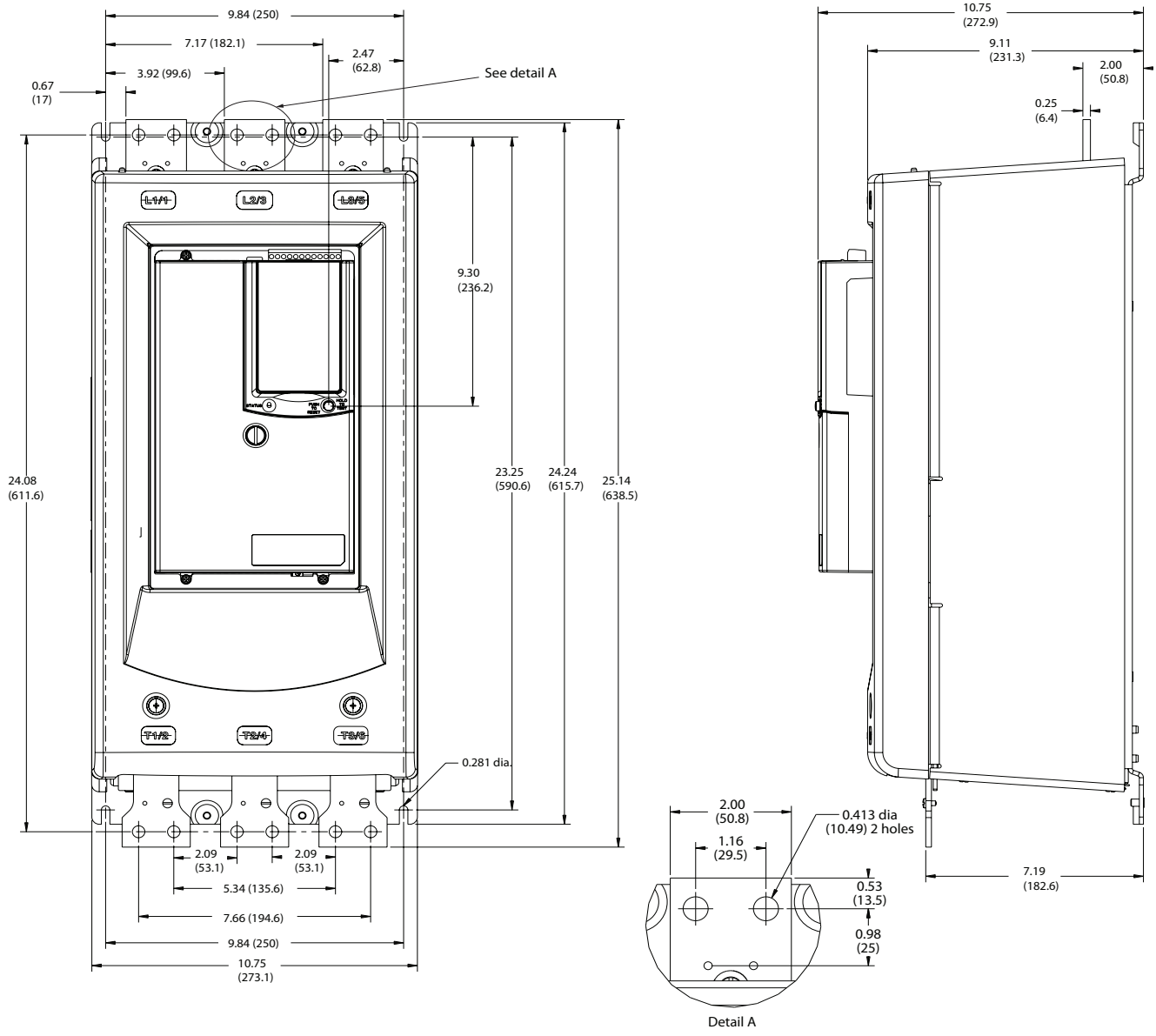
Figure 3 - Dimension of Cat. No. 150-SB Controller with Terminal Covers and MOV Options



Catalog Number	Approximate Shipping Weight
150-SB1…	15.92 kg 35.1 lb
150-SB2…	
150-SB3…	
150-SB4…	

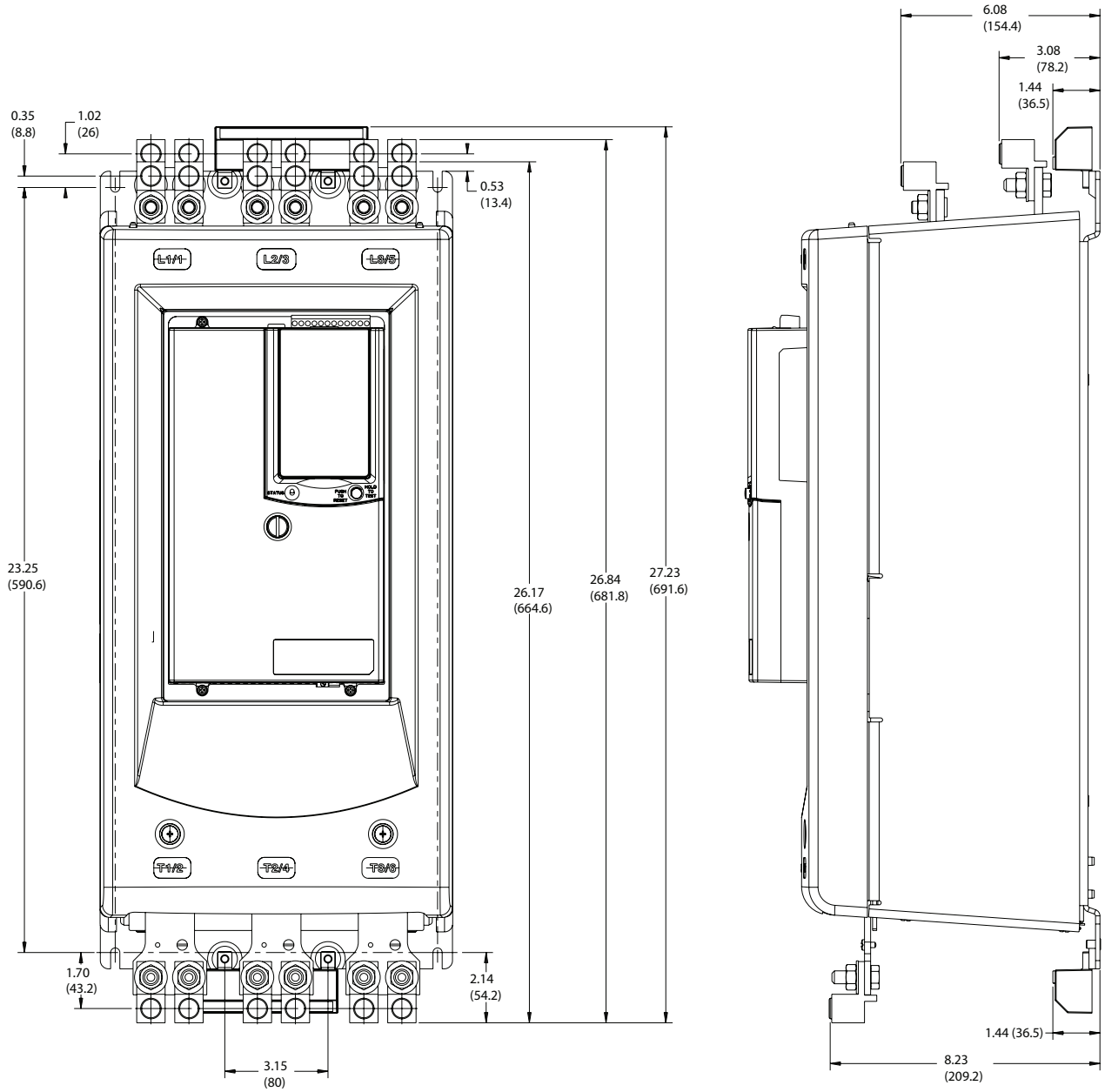
Cat. No. 150-SC… Controllers

Figure 4 - Dimensions of Cat. No. 150-SC Controller



Catalog Number	Approximate Shipping Weight
150-SC1…	47.6 kg 105 lb
150-SC2…	
150-SC3…	

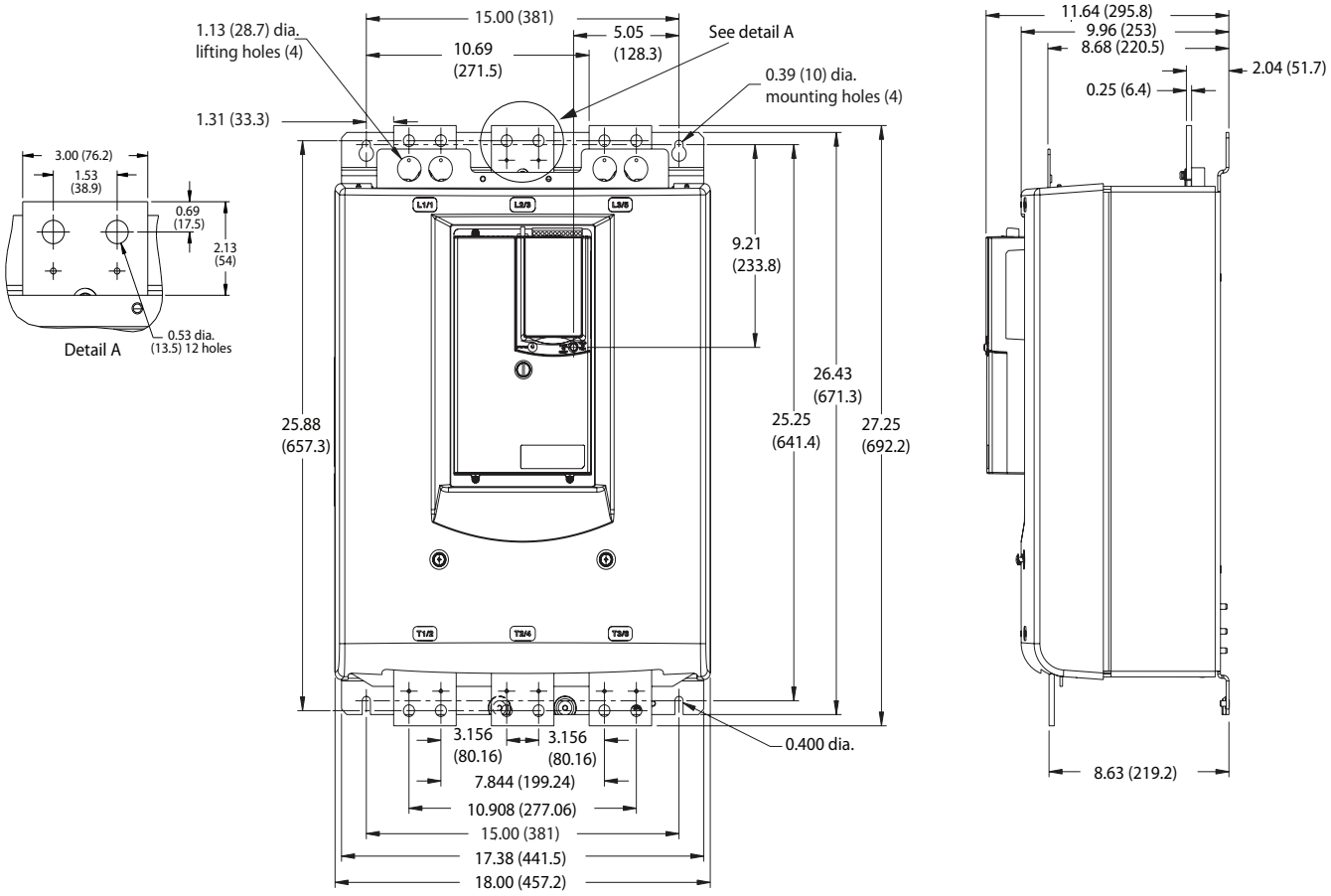
Figure 5 - Dimensions of Cat. No. 150-SC Controller with Lugs, Bypass Kit, and MOV options



Catalog Number	Approximate Shipping Weight
150-SC1…	47.6 kg 105 lb
150-SC2…	
150-SC3…	

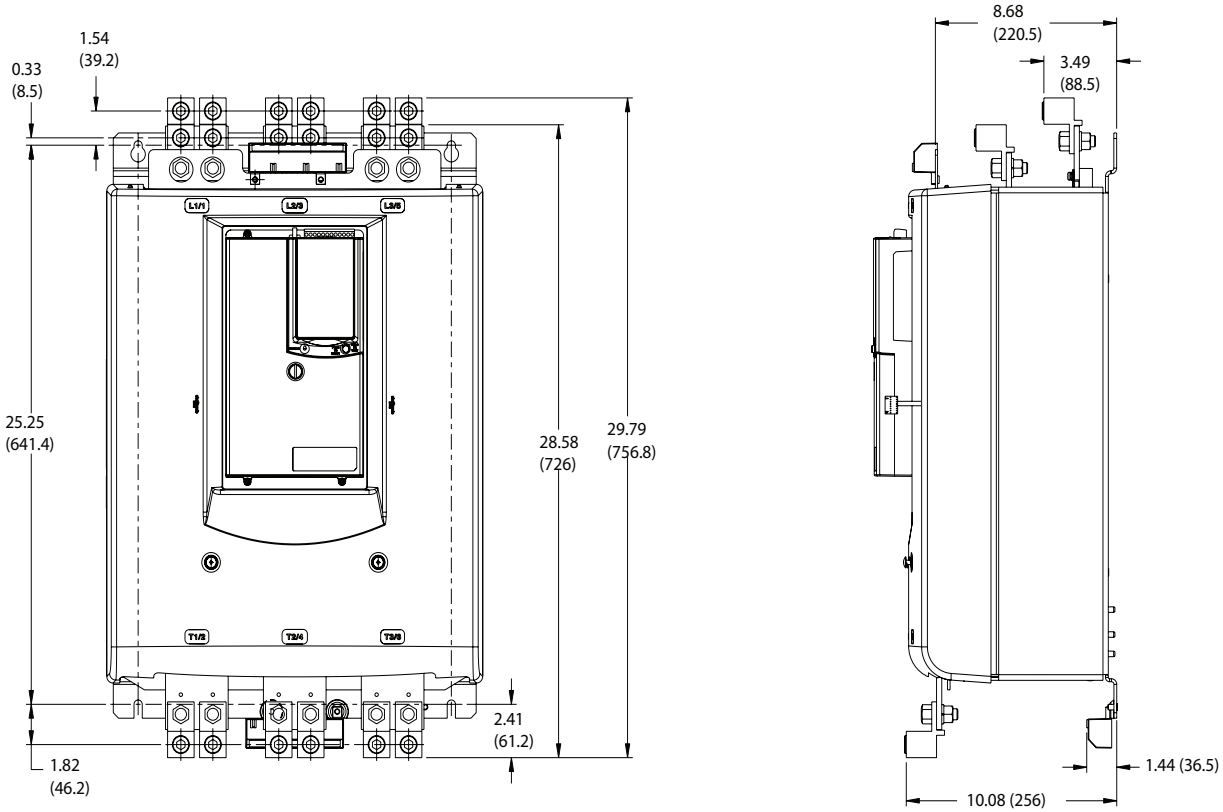
Cat. No. 150-SD… Controllers

Figure 6 - Dimensions of Cat. No. 150-SD Controller



Catalog Number	Approximate Shipping Weight
150-SD1…	77.1 kg 170 lb
150-SD2…	
150-SD3…	

Figure 7 - Dimensions of Cat. No. 150-SD Controller with Lugs, Bypass Kit, and MOV options



Catalog Number	Approximate Shipping Weight
150-SD1…	77.1 kg 170 lb
150-SD2…	
150-SD3…	

Power Wiring

See the product nameplate or the SMC-50 User Manual for device-specific information.

The SMC-50 power structure is a solid-state SCR (silicon-controlled rectifier) design capable of interfacing with 200...480V AC or 200...690V AC (690V line and 600V inside-the-delta) motors. Please verify ratings of unit before application.

The power structure incorporates true current-sensing and over temperature protection. If the application requires, an external bypass contactor may be used.

Conductor range, torque, lug, and lug kit information is provided in Table 3. Delta Distribution Block information (required for inside-the-delta connected motors) is also supplied. Typical power wiring diagrams are supplied in Figure 8.

Table 3 - Power Wiring Information

Cat. No.			150-SB…		150-SC…		150-SD…	
Rating [A]			90…180	155…311	210…320	363…554	361…520	625…900
Configuration			Line/Wye	Inside-the-Delta	Line/Wye	Inside-the-Delta	Line/Wye	Inside-the-Delta
SMC Lugs	**Torque**	**Lug-Bus**	23 N•m (200 lb•in.)	23 N•m (200 lb•in.)	23 N•m (200 lb•in.)	23 N•m (200 lb•in.)	28 N•m (250 lb•in.)	28 N•m (250 lb•in.)
		Wire-Lug	31 N•m (275 lb•in.)	31 N•m (275 lb•in.)	31 N•m (275 lb•in.)	31 N•m (275 lb•in.)	42 N•m (375 lb•in.)	42 N•m (375 lb•in.)
	Max No. Lugs/Pole	**Line Side**	1	1	2	2	2	2
		Load Side	1	1	2	2	2	2
	Conductor Range		16…120 mm^2 (#6…250 MCM)	16…120 mm^2 (#6…250 MCM)	16…120 mm^2 (#6…250 MCM)	16…120 mm^2 (#6…250 MCM)	25…240 mm^2 (#4…500 MCM)	25…240 mm^2 (#4…500 MCM)
	Wire Strip Length [mm]		18…20	18…20	18…20	18…20	18…25	18…25
	Lug Kit Cat. No.		199-LF1	199-LF1	199-LF1	199-LF1	199-LG1	199-LG1
Delta Distribution Block	**Torque**	**Line**	42 N•m (375 lb•in.)			67.8 N•m (600 lb•in.)		67.8 N•m (600 lb•in.)
		Load	42 N•m (375 lb•in.)			31 N•m (275 lb•in.)		67.8 N•m (600 lb•in.)
	Qty		3			1		3
	Conductor Range	**Line**	25…240 mm^2 (#4…500 MCM)			54…400 mm^2 (1/0…750 MCM)		54…400 mm^2 (1/0…750 MCM)
		Load	25…240 mm^2 (#4…500 MCM)			16…120 mm^2 (#6…250 MCM)		54…400 mm^2 (1/0…750 MCM)
	Wire Strip Length [mm]	**Line**	35			45		45
		Load	35			Top Row = 23 Bottom Row = 48		45
	Lug Kit No.		Allen-Bradley 1492-BG			Marathon Special Products 1353703		Marathon Special Products 1352702

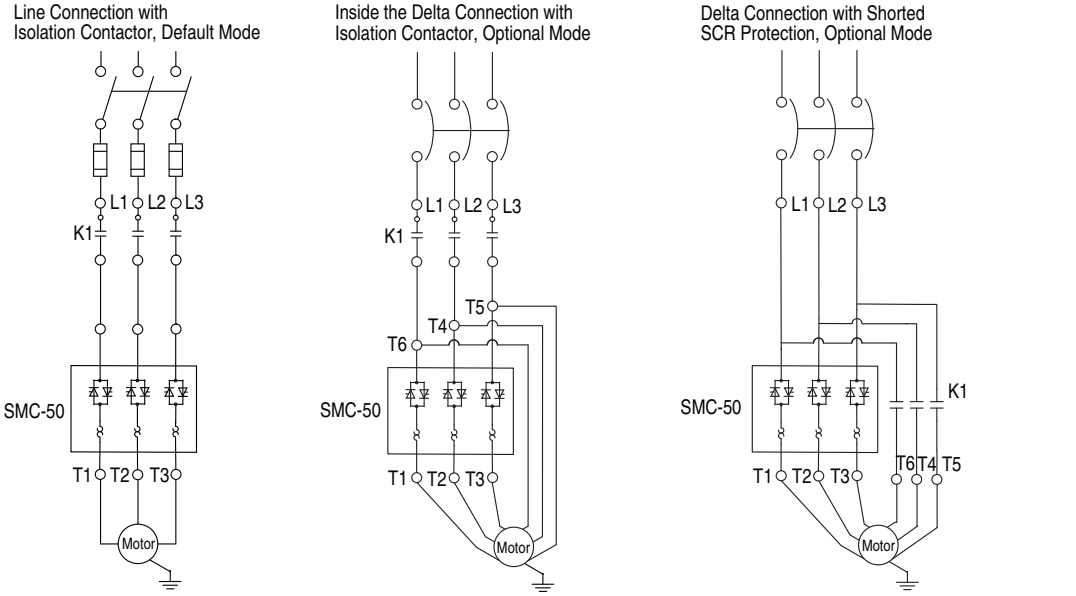
Use of Power Factor Connection Capacitors (PFCCs)

SMC-50 controllers can be installed in a system with PFCCs. The **PFCCs must only be located on the line side of the controller.** Placing the PFCCs on the load side of the SMC will result in damage to the SCRs in the SMC-50. For additional details, see the user manual.

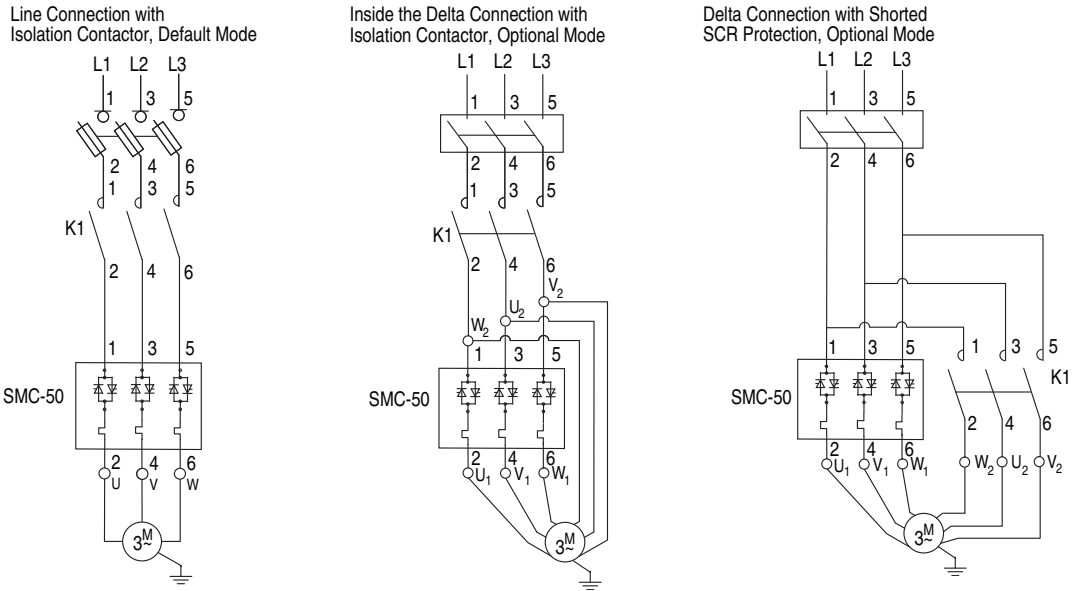
Typical Power Diagrams

Figure 8 - Power Wiring Diagrams

Diagrams per NEMA Symbology


Line Connection with Isolation Contactor, Default Mode
Inside the Delta Connection with Isolation Contactor, Optional Mode
Delta Connection with Shorted SCR Protection, Optional Mode
L1 L2 L3
K1
SMC-50
T1 T2 T3
T4 T5 T6
Motor

Diagrams per IEC Symbology



For wiring examples with bypass, please see Figure 19 ...Figure 21.

Control Wiring

Standard Control Terminal Block

SMC-50 controllers come standard with two 24V DC digital on/off inputs and two relay outputs for auxiliary control functions. The standard digital I/O wiring terminal block is located on the upper right portion of the SMC-50. The terminal block is removable.

Control Wiring Specifications

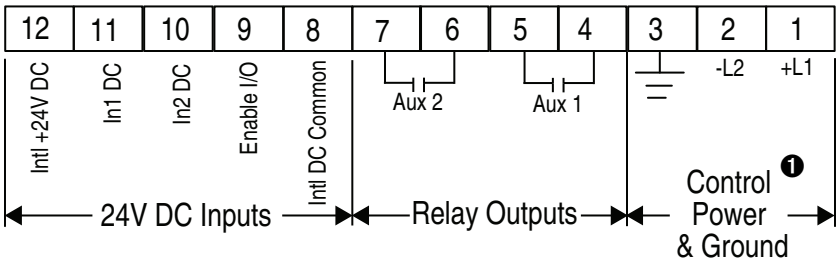
The following table provides the specifications for all SMC-50 control wiring and option module terminal blocks. Each wiring terminal will accept a maximum of two wires.

Table 4 - Control Wiring Specifications

Wire Size	0.2...2.5 mm^2 (#24...14 AWG)
Maximum Torque	0.8 N•m (7 lb•in.)
Maximum Wire Strip Length	7 mm (0.27 in.)
Screw Type	M3 Slotted

SHOCK HAZARD: To prevent the risk of electrical shock, disconnect all power sources from the controller and option module before installing or servicing it. Install the controller and option module in suitable enclosure and keep it free of contaminants.

Figure 9 - Standard Control Terminal Block Identification



❶ See the controller nameplate to verify the control power ratings (120/240V AC or 24V DC).

ATTENTION: IN1 DC (terminal 11) and IN2 DC (terminal 10) are 24V DC inputs on controllers rated 120/240V AC and on controllers rated 24V DC. Voltages exceeding specified input range may cause damage to the controller.

Terminal Number	Description
1 ❸❹	Control Power +L1
2 ❸❹	Control Power Common -L2
3	Ground — To connect to the system/control ground point.
4 ❷❸	Auxiliary Relay Contact #1
5 ❷❸	Auxiliary Relay Contact #1
6 ❷❸	Auxiliary Relay Contact #2
7 ❷❸	Auxiliary Relay Contact #2
8	DC Internal I/O Power, DC Common
9	Enable I/O
10 ❶❸	Input #2 (24V DC) (range 15…30V DC)
11 ❶❸	Input #1 (24V DC) (range 15…30V DC)
12	+24V DC Internal I/O Power

❶ Do not connect any additional loads to this terminal. Parasitic loads may cause problems with operation.

❷ When set to external bypass mode, the auxiliary contact is used to control a properly sized external contactor and overload once the motor is at full speed.

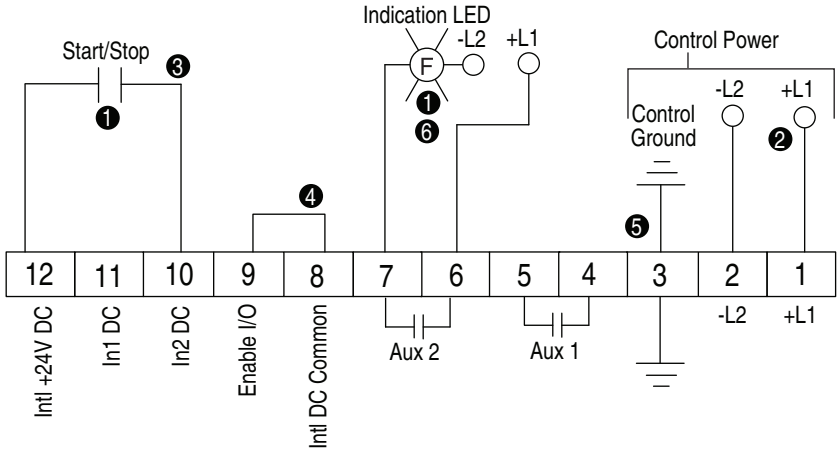
❸ RC snubbers are required when inductive loads are connected to terminal.

❹ See the controller nameplate to verify the control power ratings (120/240V AC or 24V DC)

Typical Control Wiring Examples

The following figures are control wiring diagram examples using the controller standard I/O. For additional wiring examples, see the SMC-50 User Manual.

Figure 10 - 2-Wire Control (No DPI) with Fault Indication



❶ Customer supplied.

❷ See the controller nameplate to verify the control power input ratings (120V/240V AC or 24V DC).

❸ Terminal 10 (In2) 24V DC normally open (N.O.) input is configured for Start/Stop or Start/Coast using Parameter 57. When using the Start/Stop or Start/Coast, the N.O. contact must be used.

NOTE: The controller will generate an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.

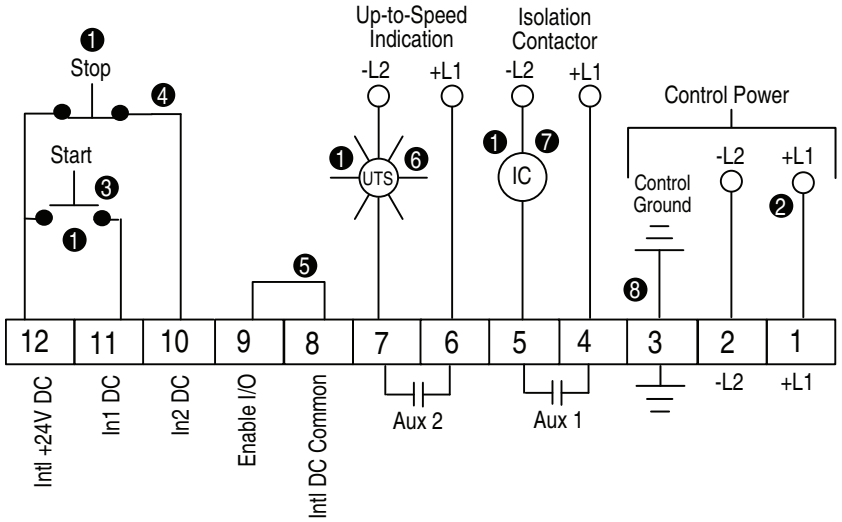
❹ A customer-supplied jumper is required to enable the controller's standard I/O operation.

❺ The terminal must be wired to the control ground to ensure reliable operation.

❻ The Aux2 output contact is configured for Fault using Parameter 176.

NOTE: Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if maintenance is required on the motor. See the typical wiring diagram for Isolation Contactor Application in the User Manual.

Figure 11 - 3-Wire Control (with or without DPI) with Up-To-Speed Indication & Isolation Contactor



❶ Customer supplied.

❷ See the controller nameplate to verify the control power input ratings (120V/240V AC or 24V DC).

❸ Terminal 11 (In1) 24V DC is configured for START input using Parameter 56.

❹ Terminal 10 (In2) 24V DC is configured for Coast, Stop Option, etc. using Parameter 57.

NOTE: The controller will generate an I/O configuration fault if any input is configured for START or SLOW speed and no input is configured for COAST or STOP.

❺ A customer-supplied jumper is required to enable the controller's standard I/O operation.

❻ The Aux2 output contact is configured for motor UTS using Parameter 176.

❼ The Aux1 output contact is configured for Normal (closed with Start command, Open with stop command) using Parameter 172.

❽ The terminal must be wired to the control ground to ensure reliable operation.

NOTE: Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if maintenance is required on the motor. See the typical wiring diagrams for Isolation Contactor Application in the User Manual.

Option Modules

SMC-50 controllers have three expansion ports. These ports provide the capability to add optional modules (e.g., additional inputs and outputs (I/O), simple start/stop parameter configuration capability, ground fault, etc.).

NOTE: The 20-COMM-X communication modules may only reside in Port 9.

ATTENTION: There is the potential to have voltage values above 220V AC on the option modules. Before removing the control module cover to access option modules, disconnect **ALL** power to the SMC-50 controller.

Figure 12 - Port Number Identification

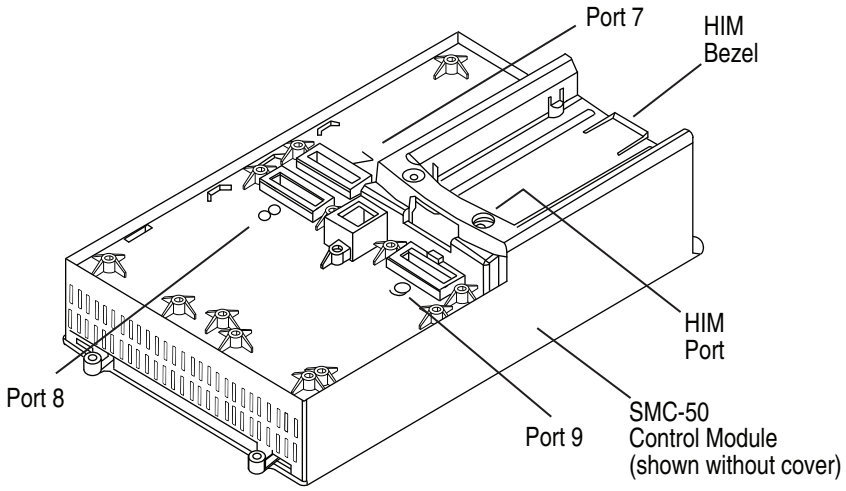


Table 5 - Port Location for Compatible Option Modules

SMC-50 Control Module Compatible Option Modules Cat. Nos.	Compatible Control Module Port			Maximum Number of this Type of Option Module per Control Module
	Port 7	Port 8	Port 9	
150-SM2: Ground Fault/PTC/External CT	Yes	Yes	No	1
150-SM3: Analog I/O	Yes	Yes	Yes	3
150-SM4: Digital I/O	Yes	Yes	Yes	3
150-SM6: Parameter Configuration	Yes	Yes	Yes	1
20-COMM-X ❶❷: Communications	No	No	Yes	1

❶ See the SMC-50 user manual for a list of compatible 20-COMM-X modules.

❷ When installed in an SMC-50 controller, 20-COMM-X modules physically reside in the space assigned to Port 9, but connect to DPI Port 4 with the ribbon cable that is supplied with the communication module.

Optional Cat. No. 150-SM4 Digital I/O Module

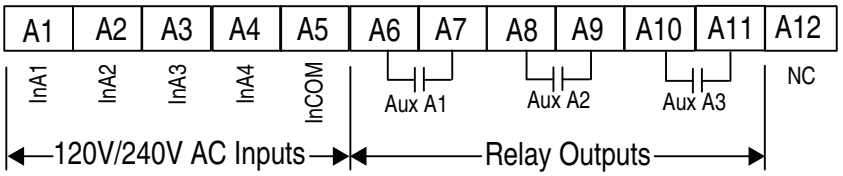
A Cat. No. 150-SM4 Digital I/O Option Module provides four 120...240V AC digital on/off inputs and three relay outputs to provide additional auxiliary control or indications (e.g., up-to-speed (UTS), alarm, etc.) functions. The 150-SM4 module can be located in any of the three control module option ports (See Figure 12). Up to three 150-SM4 modules can be used with a single control module. The 150-SM4 module terminal block used to wire the I/O is removable.

NOTE:

1 When installed in Control Module Port 7, the orientation of the module terminal block is rotated 180° along with its terminals.

2 The Cat. No. 150-SM4 Digital I/O Module can NOT be configured using a 150-SM6 PCM. This module can be configured using a 20-HIM-A6, network card, or communications software (e.g., Connected Components Workbench [CCW]).

Figure 13 - Optional Digital I/O Module Terminal Identification



Terminal Number	Description
A1 ❶	Optional Input #1 (120/240V AC)
A2 ❶	Optional Input #2 (120/240V AC)
A3 ❶	Optional Input #3 (120/240V AC)
A4 ❶	Optional Input #4 (120/240V AC)
A5 ❸	Input Common
A6 ❷❸	Optional Auxiliary Relay Contact #1
A7 ❷❸	Optional Auxiliary Relay Contact #1
A8 ❷❸	Optional Auxiliary Relay Contact #2
A9 ❷❸	Optional Auxiliary Relay Contact #2
A10 ❷❸	Optional Auxiliary Relay Contact #3
A11 ❷❸	Optional Auxiliary Relay Contact #3
A12	NO CONNECT

❶ Do not connect additional loads to this terminal. Parasitic loads may cause problems with operation.
❷ When set to external bypass mode, the auxiliary contact is used to control a properly sized external contactor once the motor is at full speed. See Figure 19, Figure 20, and Figure 21.
❸ RC snubbers are required when inductive loads are connected to terminal.

Optional Cat. No. 150-SM3 Analog I/O Module

An optional Cat. No. 150-SM3 Analog I/O Module provides two analog inputs (voltage or current) and two analog outputs (voltage or current), seeTable 6 for specifications.

The 150-SM3 module can be located in any of the three control module option ports (See Figure 12). Up to three 150-SM3 modules can be used with a single control module. The 150-SM3 module terminal block used to wire the I/O is removable.

NOTE:

1 When installed in Control Module Port 7, the orientation of the module terminal block is rotated 180° along with its terminals.

2 The Cat. No. 150-SM3 Analog I/O Module can NOT be configured using a 150-SM6 PCM. This module can be configured using a 20-HIM-A6, network card, or communications software (e.g., Connected Components Workbench [CCW]).

Figure 14 - Analog I/O Module Wiring Diagram

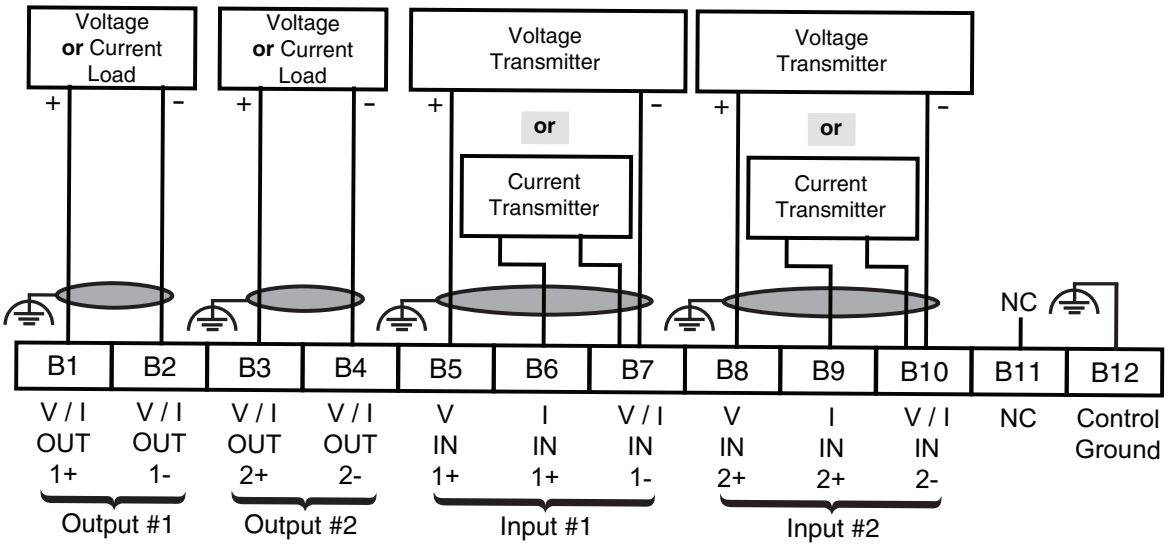


Table 6 - Cat. No. 150-SM3 Input and Output Specifications

Control Circuit	Specification	
150-SM3 Optional inputs: Terminals B5…B10	Number of Inputs	2 differential inputs
	Normal Operating Input Ranges	±10V, 0…10V, 0…5V, 1…5V, 0…20 mA, 4…20 mA
	Full Scale Operating Input Ranges	±10.5V, 0…10.5V, -0.5…5.25V, 0.5…5.25V, 0…21 mA, 3.5…21 mA
	Input Resolution	16 bit (sample rate = 60 Hz)/13 bit (sample rate = 250 Hz)
	Data Refresh Rate:	Filter dependent: 100 ms (sample rate = 60Hz);24 ms (sample rate = 250Hz)
	Rated Working Voltage	24V DC / 17V AC
	Common Mode Voltage Range	±10V DC / channel
	Input Impedance	220 kΩ: voltage mode 249 Ω: current mode
	Input Channel Diagnostics	Over and Under Range and Open Circuit
	Open Circuit Detection Time	Positive Full Scale Reading: within 3 seconds (max)
	Maximum Overload at Input Terminals	Voltage: ±24V DC continuous at 0.1 mA Current: ±30 mA continuous at 7V DC
	External Calibration	Not required: auto-calibration performed by the module if required to meet specs.
	Module Isolation to Control Board	Yes (1000V AC)
	Removable Terminal Block	Yes (Cat. No.150-SM3RTB as a spare replacement part)
	Cable Type	Belden 8760 (or equiv.) 0.750 mm^2 (18 AWG twisted pair 100% shield with drain)

Control Circuit	Specification	
150-SM3 Optional outputs: Terminals B1…B4	Number of Outputs	2 Single-ended
	Normal Operating Output Ranges	±10V, 0…10V, 0…5V, 0…20 mA, 4…20 mA
	Full Scale Operating Output Ranges	±10.5V, 0…10.5V, -0.5…5.25V, 0…21 mA, 3.5…21 mA
	Output Resolution ±10.5V, 0 …10.5V, -0.5…5.25V, 0.5…5.25V, 0…21 mA, 3.5 …21 mA	16 bit (15 plus sign bipolar)
	Resistive Load on Current Output	0…750 Ω
	Load Range on Voltage Output	1 kΩ at 10V DC
	Max. Inductive Load (Current Outputs)	15 mH
	Max. Capacitive Load (Voltage Outputs)	100 μF
	Overall Accuracy	Voltage Terminal: ±0.5% full scale at 25° C Current Terminal: ±0.35% full scale at 25° C
	Accuracy Drift with Temperature	±5 PPM / ° C
	Output Impedance	15 Ω (typical)
	Open and Short-Circuit Protection	Yes
	Maximum Short-Circuit Current	45 mA
	Output Overvoltage Protection	Yes

Optional Cat. No. 150-SM6 Parameter Configuration Module (PCM)

The Cat. No. 150-SM6 PCM provides simple and limited configuration of the SMC-50. This PCM can be inserted into any control module option port (7, 8, or 9). Only one PCM is allowed per control module.

Parameters that **are** configured by the PCM will appear as read-write parameters to other configuration devices whose values represent the switch settings. The parameter values set by the PCM are stored in the control module memory.

Parameters that **are not** defined and therefore are not configurable by the 150-SM6 PCM can be configured through other means (e.g., Human Interface Module (HIM), Connected Components Workbench (CCW), DriveExplorer or DriveExecutive software), if necessary.

Additional information regarding parameter configuration using a PCM is in Chapter 3.

Additional Options

Optional Cat. No. 150-SM2 Positive Temperature Coefficient (PTC), Ground-Fault, & External Current Transformer Option Module

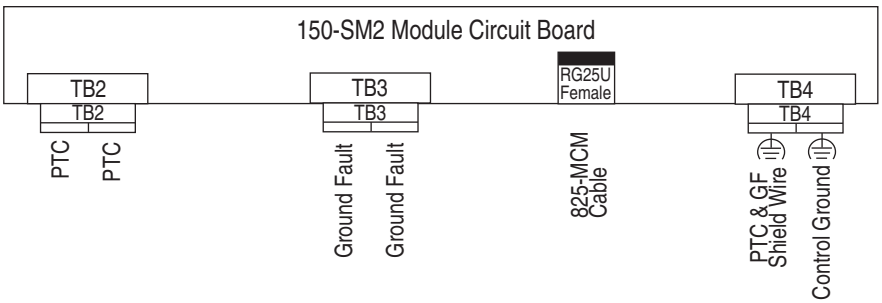
An optional Cat. No. 150-SM2 module provides connectivity to external PTC motor winding temperature sensors, ground-fault, and current transformer sensors.

The 150-SM2 module can be located in control module Port 7 or 8. Only one 150-SM2 module is allowed to be used with the control module (See Figure 12). All of the individual terminal blocks (TB2, TB3, and TB4) are removable. The RG25U female connector provides a connection point for the male-to-male cable provided with the 825-MCM current sensor/converter module.

1 When installed in Control Module Port 7, the orientation of the module terminals is rotated 180° along with its terminals.

NOTE: **2** The Cat. No. 150-SM2 Option Module can NOT be configured using a 150-SM6 PCM. This module can be configured using a 20-HIM-A6, network card, or communications software (e.g., Connected Components Workbench [CCW]).

Figure 15 - Circuit Board



Current Feedback Sensor (825-MCM Converter Module)

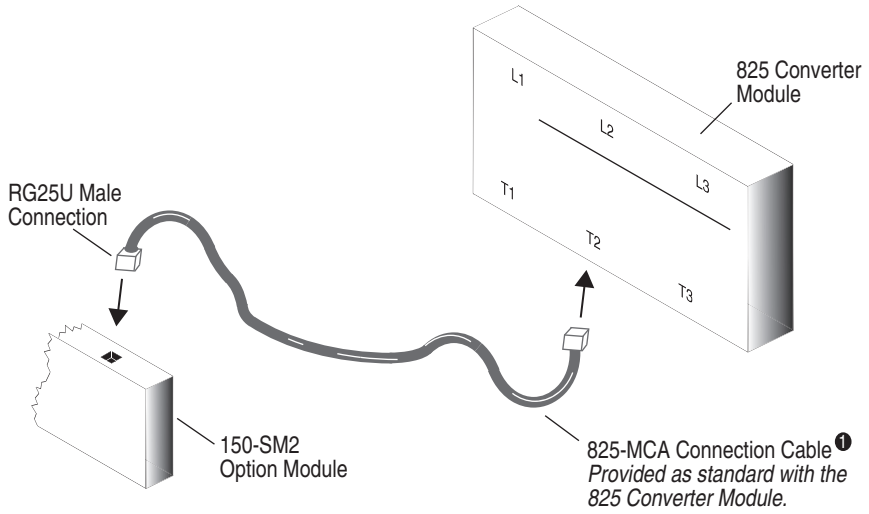
External Bypass Operation

An external 825-MCM Current Sensing Converter Module may be required to provide current feedback to the SMC-50 when it is used with an external bypass contactor (bypass mode). The external current feedback is used for all current measurement and current protection functions while the controller is in the external bypass mode. In all other modes (e.g., starting, stopping, slow speed, etc.), internal current feedback signals are used.

See Bypass Diagrams on page 27 for a listing of components required for bypass operation.

The following figure shows the connection of the 825-MCM to the SMC-50's 150-SM2 option module.

Figure 16 - Converter to Option Module Connection



❶ The cable length is fixed at 4 meters. Only the cable provided with the converter can be used. The use of any other cable will result in incorrect data from the converter and incorrect controller operation.

Ground Fault Feedback Sensor

The SMC-50 can provide ground-fault indication when used with the 150-SM2 option module and Cat. No. 825-CBCT Core Balance Ground Fault Sensor. This sensor mounts separately from the SMC-50 and must be placed within 3 meters of the option module. A customer-supplied shielded, twisted pair cable for wiring the sensor to the 150-SM2 module must meet the requirements outlined in the table below.

Table 7 - Ground-Fault Sensor Cable Requirements

Wire Type	Shielded, twisted pair
Wire Cross Section	0.2...2.5 mm^2 (#24...14 AWG)
Terminal Torque	0.8 N•m (7 lb - in.)

ATTENTION: The ground fault sensing feature of the SMC-50 is intended for monitoring purposes only and not as a ground fault circuit interrupter for personnel protection as defined in Article 100 of the NEC. The ground fault sensing feature has not been evaluated for conformance to UL 1053.

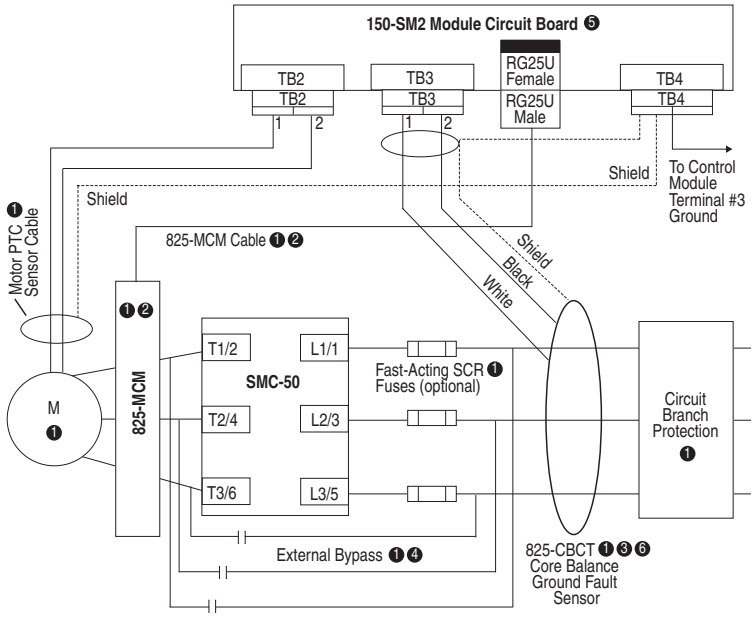
PTC Thermistor Sensors

The 150-SM2 option module allows the SMC-50 to interface with motor PTC sensors to monitor motor temperature. The following table defines the PTC input and response ratings.

Table 8 - PTC Input & Response Ratings

Response Resistance	3400 Ω ± 150 Ω	
Reset Resistance	1600 Ω ± 100 Ω	
Short-Circuit Trip Resistance	25 Ω ± 10 Ω	
Maximum Voltage at PTC Terminals	R_{PTC} = 4 KΩ	< 7.5V
	R_{PTC} = open	30V
Maximum Number of Sensors Connected in Series	6	
Maximum Cold Resistance of PTC Sensor Chain	1500 Ω	
Response Time	800 ms	

Figure 17 - Combined Wiring Diagram of All Cat. No. 150-SM2 Sensors



❶ Customer-supplied.

❷ The 825-MCM can be used with or without an external bypass contactor. If an external bypass contactor is used then the 825-MCM must be installed in order to use current-based motor protective features including the motor overload feature. Cable length is 4 meters. Only the cable provided with the 825-MCM is compatible with the 150-SM2.

❸ The 825-CBCT core balance sensor mounts separately from the SMC-50 and must be placed within 3 meters of the SMC-50. When connecting the 825-CBCT ground-fault sensor, the secondary of the CT must be shorted until connection to the 150-SM2 module is complete.

❹ See the user manual for additional bypass configurations (e.g., emergency run-off bypass) and application considerations.

❺ To meet product susceptibility requirements, a single ferrite core must be placed around any or all sensor (e.g., PTC, ground fault, etc.) wires connected to the 150-SM2 Option Module. The recommended core is a Fair-Rite Products Corp Part Number 0431167281 or equivalent.

❻ Ensure the 150-SM2 Turns Ratio, Parameter X.5, is configured to match the 825-CBCT Turns Ratio 100:1 (X.5=100).

Bypass Diagrams

For bypass operation, a bypass contactor must be supplied. An auxiliary relay contact that is programed for external bypass is used to control a properly sized external contactor once the motor is at full speed.

Overload protection can be accomplished in several ways.

SMC-50 Providing Overload Function

- Frame B (90...180 A)
  - Required parts: Cat. Nos. 150-SM2, 825-MCM180 converter module. See Figure 19.
- Frame C and D (210...320 A and 361...520 A)
  - Using bypass kit
    - Required parts: Cat. No. 150-SCBK (Frame C) or 150-SDBK (Frame D) See Table 9 and Figure 20.

      Note: When using the Cat. No. 150-SCBK or 150-SDBK bypass kit, the controller firmware must be FRN 3.001 or higher.
  - Using 825 and CTs
    - Required parts: Cat. Nos. 150-SM2, 825-MCM20, user supplied CTs with 5 A secondary. See Figure 18 and Figure 19.

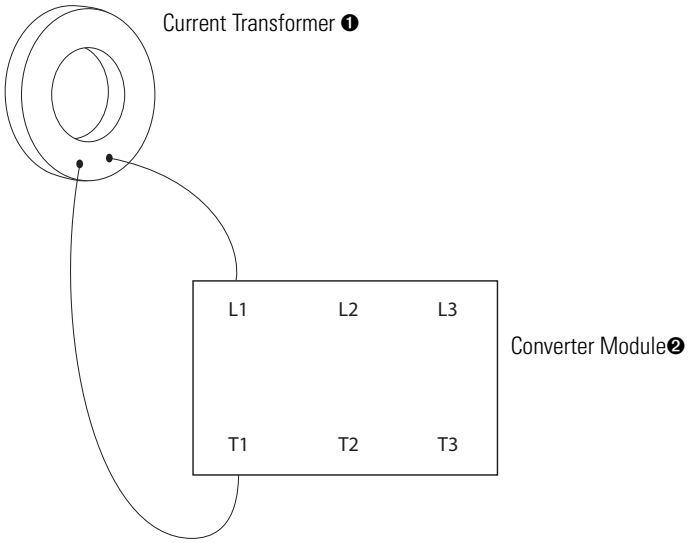
External Overload

- Frames B, C, and D
  - Bypass contactor must be fully rated to motor Hp/kW and FLA. See Figure 21.

Converter Modules

For applications in which the motor's full load current rating is greater than 180 A (311 A inside-the-delta), three additional current transformers with 5 A secondaries are required. Figure 18 illustrates the connection of the current transformers to the converter module.

Figure 18 - Current Transformer Connection to Converter Module

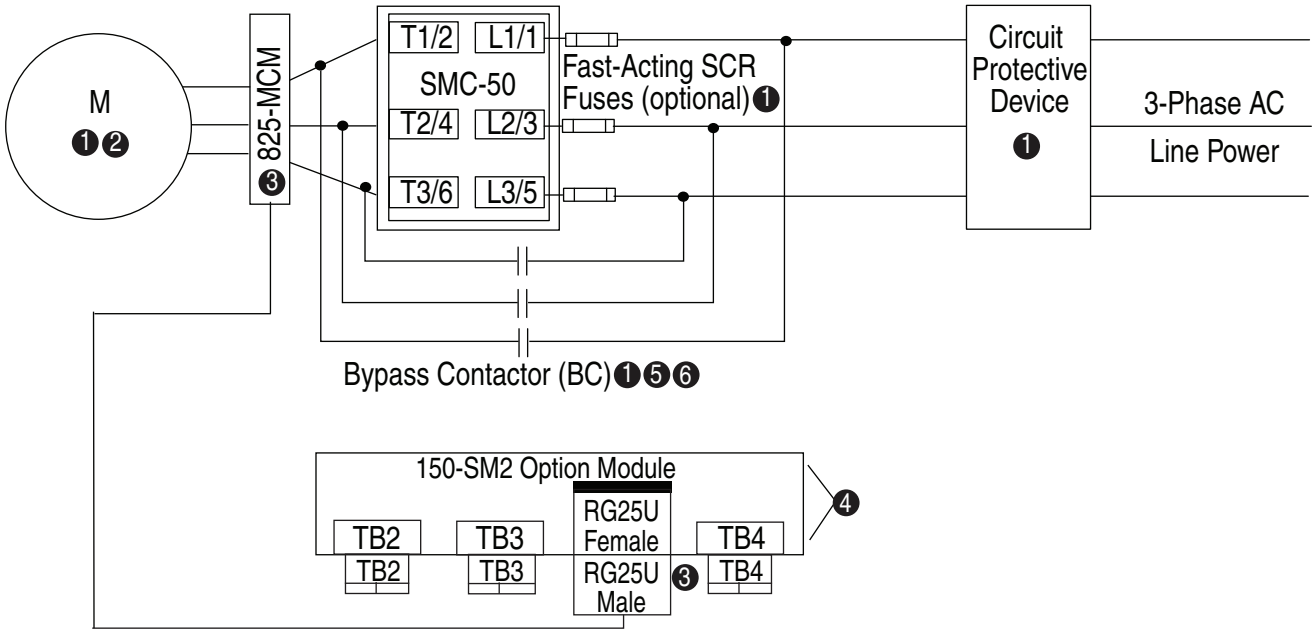


❶ Another current transformer connects L2 and T2, and another connects L3 and T3.
❷ The converter module, Cat No. 825-MCM20, must be used in these applications.

Table 9 - SMC-50 Conductor and Torque Requirements

SMC-50 Cat. No.	Lug Kit Cat. No.	Wire Strip Length [mm]	Conductor Range	Max. No. Lugs Pole		Torque		Bypass Bus Kit Cat. No.
				Line Side	Load Side	Wire-Lug	Lug-Bus	
150-SB…	1494R-N14	Long = 44.5 Short = 22.4	54…120 mm^2 (1/0…250 MCM)	1	1	31 N•m (275 lb•in.)	23 N•m (200 lb•in.)	—
150-SC…	199-LF1	18…20	16…120 mm^2 (#6…250 MCM)	2	2	31 N•m (275 lb•in.)	23 N•m (200 lb•in.)	150-SCBK
150-SD…	199-LG1	18…25	25…240 mm^2 (#4…500 MCM)	2	2	42 N•m (375 lb•in.)	28 N•m (250 lb•in.)	150-SDBK

Figure 19 - Wiring Diagram using 825 Converter Module and 150-SM2 Devices with Bypass Contactor



❶ Customer supplied.

❷ Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if maintenance is required on the motor. See the Isolation Contactor Applications for details.

❸ In Bypass Contactor RUN operation, the 825-MCM and the 150-SM2 module provide current-based protective feedback features including overload. Only the cable provided with the 825-MCM converter can be used in this configuration. The maximum cable length is 4 m, thus the 825-MCM must be located within 4 m of the SMC-50.

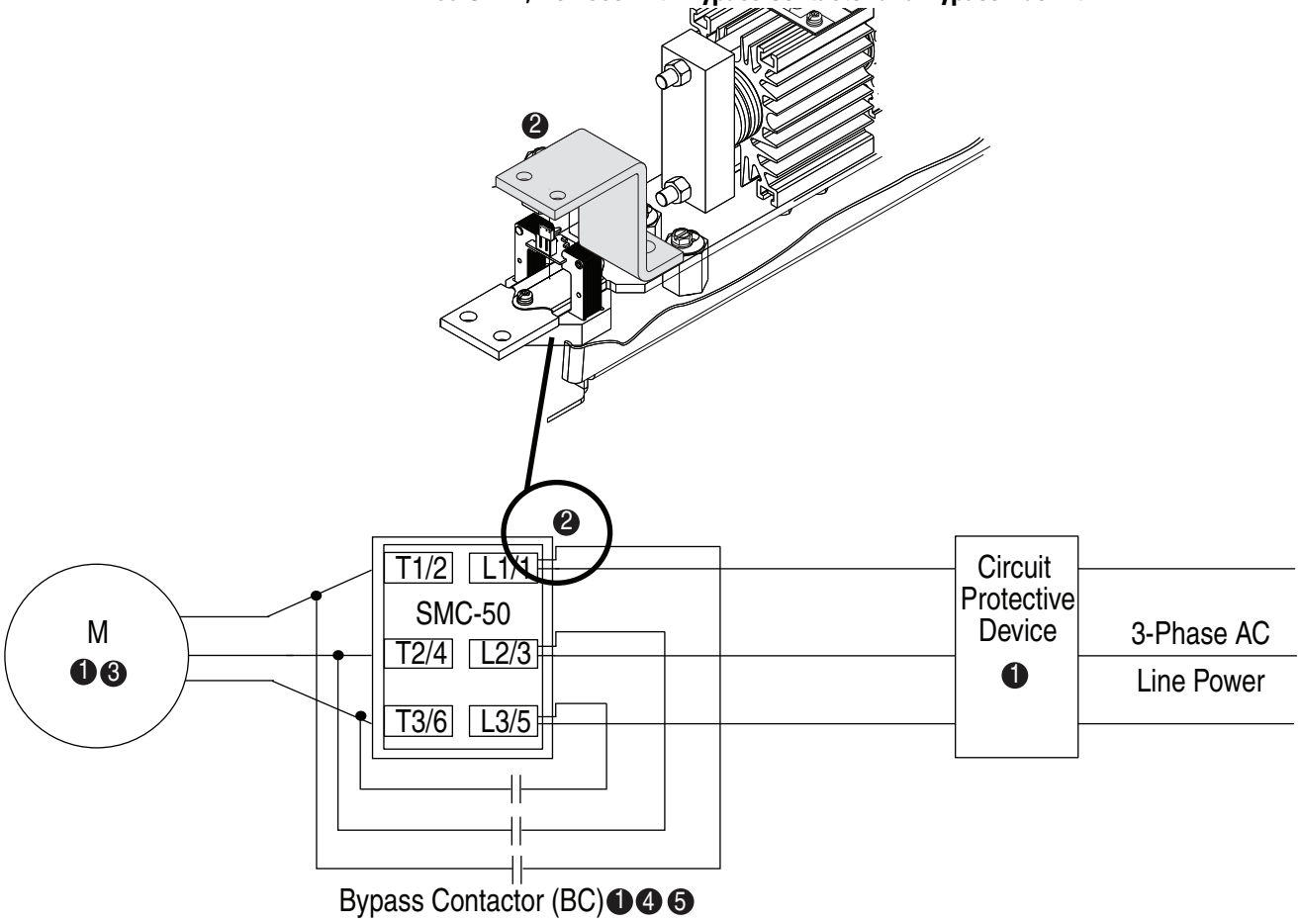
❹ The order of the terminal numbers for the 150-SM2 module can be reversed depending on which expansion slot it is located in the control module. However, the function associated with the terminal number remains the same.

❺ Bypass must be controlled by an auxiliary contact of SMC-50 configured to external bypass.

❻ In North America, size the bypass contactor per the motor Hp and FLA. In IEC, size the bypass contactor per the motor AC-1 rating. The short-circuit rating of the bypass contactor must be similar to that of the SMC-50.

NOTE: In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the winding(s) of the motor. This could potentially result in overheating or damage to the motor. To prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker capable of interrupting the motor's locked rotor current on the line side of the SMC-50 is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 auxiliary contacts configured to NORMAL.

Figure 20 - Wiring Diagram for Frame C (Cat. No. 150-SC…) or Frame D (Cat. No. 150-SD…) Devices with Bypass Contactor and Bypass Bus Kit



❶ Customer supplied.

❷ SMC-50 Bypass bus kit Cat. No. 150-SCBK (Frame C; Cat. No. 150-SC…) or 150-SDBK (Frame D; Cat. No. 150-SD…).

NOTE: Controller FRN 3.001 or higher is required.

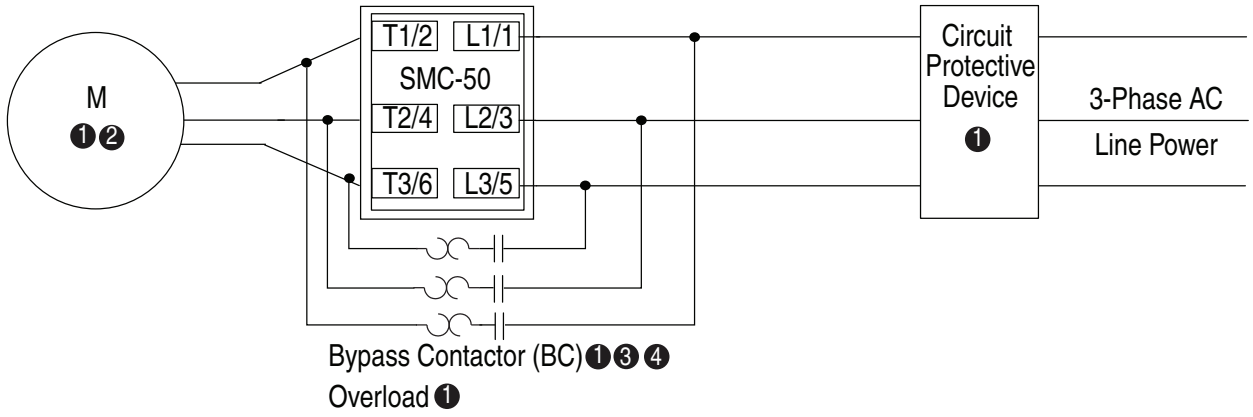
❸ Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if maintenance is required on the motor. See the Isolation Contactor Applications for details.

❹ Bypass must be controlled by an auxiliary contact of the SMC-50 that is configured for external bypass.

❺ In North America, size the bypass contactor per the motor Hp and FLA. In IEC applications, size the bypass contactor per the motor AC-1 rating. The short-circuit rating of the bypass contactor must be similar to that of the SMC-50.

NOTE: In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the winding(s) of the motor. This could potentially result in overheating or damage to the motor. To prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker capable of interrupting the motor's locked rotor current on the line side of the SMC-50 is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 auxiliary contacts configured to NORMAL.

Figure 21 - Wiring Diagram for All Frames (Cat. No. 150-S…) with Bypass Contactor and External Overload



❶ Customer supplied.

❷ Due to current leakage through an SCR in the OFF state (controller stopped), some form of upstream line power isolation is recommended if maintenance is required on the motor. See the Isolation Contactor Applications for details.

❸ Bypass must be controlled by an auxiliary contact of the SMC-50 that is configured for external bypass.

❹ Bypass contactor must be fully rated to motor Hp/kW and FLA.

NOTE: In addition to a small amount of leakage current flowing through an SCR in the off-state, failure of one or more solid-state power switching components allows uncontrolled current to flow to the winding(s) of the motor. This could potentially result in overheating or damage to the motor. To prevent potential personal injury or equipment damage, the installation of an isolation contactor or shunt trip-type circuit breaker capable of interrupting the motor's locked rotor current on the line side of the SMC-50 is recommended. Operation of the isolation device should be coordinated using one of the SMC-50 auxiliary contacts configured to NORMAL.

Notes:

Programming

Parameter Configuration/ Programming

Parameter Configuration using the Cat. No. 150-SM6 Parameter Configuration Module (PCM)

The Cat. No. 150-SM6 PCM provides simple and limited configuration of the SMC-50. This PCM can be inserted into any control module option port (7, 8, or 9). Only one PCM is allowed per control module.

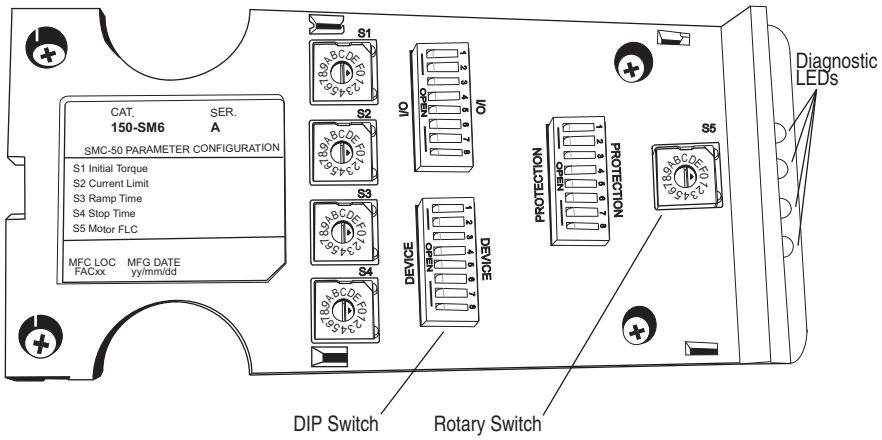
Parameters that **are** configured by the PCM will appear as read-write parameters to other configuration devices and whose values represent the switch settings. The parameter values set by the PCM are stored in the control module memory. Therefore, using the appropriate removal procedure (remove all power to Control Module and Power Module), the PCM can be removed from the control module with its parameter settings retained.

When using a Cat. No. 150-SM6 PCM to configure the SMC-50, it should be noted that the following features, functions, and modes are not configurable:

- Full voltage start
- Torque ramp start
- External brake stop
- Option card I/O configuration (Cat. No. 150-SM... option modules)
- External bypass
- Specialized output relay configuration (e.g., network control, DeviceLogix, auxiliary control)
- Specialized operation modes/features
  - Dual ramp, motor winding heater, emergency run
  - Overload select (Class)
  - Adjustment of slow speed set point

Parameters that **are not** defined and therefore are not configurable by the Cat. No. 150-SM6 PCM can be configured through other means (e.g., Human Interface Module (HIM), Connected Components Workbench (CCW), DriveExplorer or DriveExecutive software), if necessary.

Figure 22 - DIP Switch & Rotary Switch Locations



The Cat. No. 150-SM6 PCM contains five rotary switches, S1...S5, each with designations 0...F and three banks of ON/OFF 8-switch DIP switches.

Table 10, Table 11, and Table 12 define the functions of the five rotary switches.

Table 10 - Rotary Switch Position Settings & Resulting Values — Torque and Current Limit Configurations

S1 = Initial Torque Configuration — Controller Parameter 51			
Position Setting	**Resulting Initial Torque Value [% motor torque]**	**Position Setting**	**Resulting Initial Torque Value [% motor torque]**
0	10	8	58
1	16	9	64
2	22	A	70 (default)
3	28	B	76
4	34	C	82
5	40	D	88
6	46	E	94
7	52	F	100
S2 = Current Limit Configuration — Controller Parameter 53			
Position Setting	**Resulting Current Limit Value [% FLC]**	**Position Setting**	**Resulting Current Limit Value [% FLC]**
0	200	8	360 (default)
1	220	9	380
2	240	A	400
3	260	B	420
4	280	C	440
5	300	D	460
6	320	E	480
7	340	F	500

Table 11 - Rotary Switch Position Settings & Resulting Values — Ramp and Stop Time Configurations

S3 = Ramp Time Configuration — Starting — Controller Parameter 50			
Position Setting	**Starting Ramp Time [s]**	**Position Setting**	**Starting Ramp Time [s]**
0	0.1	8	16
1	2	9	18
2	4	A	20
3	6	B	22
4	8	C	24
5	10 (default)	D	26
6	12	E	28
7	14	F	30
S4 = Stop Time Configuration — Controller Parameter 66			
Position Setting	**Stop Time [s]❶**	**Position Setting**	**Stop Time [s] ❶**
0	Coast -to-Stop (default)	8	16
1	2	9	18
2	4	A	20
3	6	B	22
4	8	C	24
5	10	D	26
6	12	E	28
7	14	F	30

❶ When the braking STOP MODE is selected (device configuration bank switch #3 and #4), the controller multiplies the selected stop time by ten.

Table 12 - Rotary Switch Position Settings & Resulting Values — Motor FLC Configurations

S5 = Motor Full Load Current (FLC) Configuration — Controller Parameter 78			
Position Setting	**FLC ❶❷ [% of controller's max]**	**Position Setting**	**FLC ❶❷ [% of controller's max]**
0	40 (default)	8	72
1	44	9	76
2	48	A	80
3	52	B	84
4	56	C	88
5	60	D	92
6	64	E	96
7	68	F	100

❶ Since a set of switches do not provide the resolution to enter all possible FLC combinations like a keypad, switch S5 allows you to configure the motor's FLC in the SMC-50 by using a percentage (%) of the controller's rated FLC (e.g., 90 A, 110 A, 180 A, etc.).

EXAMPLE

For a 60 A motor and a 90 A controller:

% of controller's max FLC for a 60 A motor = 64% of 90 A (57.6 A), or Switch Position 6

❷ To determine the S5 switch setting for an inside-the-delta motor configuration, use the following equations:

Step 1

$$\frac{\text{Motor Nameplate FLC}}{1.73} = X$$

Step 2

$$\frac{X}{\text{SMC-50 Controller Rating}} \times 100 = \text{S5 Switch Setting}$$

EXAMPLE

Step 1

$$\frac{100\ \text{A}}{1.73} = 57.8\ \text{A}$$

Step 2

$$\frac{57.8\ \text{A}}{90\ \text{A}} \times 100 = \mathbf{64\%}$$

Result From the result of 64%, the S5 switch setting is position 6.

NOTE:

1 If the calculated value does not match a switch position, use the previous (lower percentage) switch setting.

2 The inside-the-delta motor configuration can be selected using Parameter 44 (Motor Connection) or automatically during a controller tuning process. The tuning process is done during the initial system start after changing any of the tuning parameters and initializing a start or by pressing and holding the SMC-50 reset push button for at least 10 seconds with the motor stopped and then initializing a start.

The following tables define the functions for the three banks of ON/OFF 8-switch DIP switches. Each of the three banks is defined by a high level, functional name with each switch having a unique function.

Table 13 - ON/OFF 8-Switch DIP Switch Definitions — Device

DEVICE Configuration Bank (0 = Switch OPEN)		Switch Number							
		#1	#2	#3	#4	#5	#6	#7	#8
Starting Mode— Controller Parameter 49	Linear Speed Acceleration (default)	0	0						
	Current Limit	0	1						
	Soft Start	1	0						
	Pump Start	1	1						
Stop Mode ❶❷— Controller Parameter 65	Linear Speed Deceleration (default)			0	0				
	Soft Stop			0	1				
	Braking			1	0				
	Pump Stop			1	1				
Energy Saver ❸— Controller Parameter 193	Enable					1			
	Disable (default)					0			
Braking Current — Controller Parameter 69	50%						0	0	0
	100%						0	0	1
	150%						0	1	0
	200% (default)						0	1	1
	250%						1	0	0
	300%						1	0	1
	350%						1	1	0
	400%						1	1	1

❶ When the Stop Mode is configured as (a) Linear Speed Decel, (b) Soft Stop, (c) Pump Stop, and the Stop Time (rotary switch S4) is set to zero, a Coast stop will result. A non-zero Stop Time value for the three previously listed Stop Modes defines the time to stop period which is based on that specific configuration.

❷ If the Stop Mode is configured as Braking, then the Stop Time setting (Rotary Switch S4) is used to select either the Automatic Zero Speed Detection method (Stop Time is set to zero) or the Timed Brake method (Stop Time is not set to zero).

❸ With the Energy Saver switch (#5) set to ENABLE, the Energy Saver Level, Parameter 193, is automatically configured by the PCM to 0.25.

NOTE: **1** With the Automatic Zero Speed Detection method, the controller applies the user-selected Braking Current defined by the Device Configuration Switch Bank. Switch #6, #7, and #8 senses a motor Zero Speed condition and automatically stops the braking process.

2 With the Timed Brake method, the user-selected Braking Current is applied for the user-configured Stop Time regardless of the motor speed (e.g., Automatic Zero Speed Detection disabled). The Timed Brake method can be used in applications where detecting zero speed is ineffective or when braking the motor to a complete stop results in random overload trips. With this method, braking is applied for a fixed time equal to the Stop Time setting (Rotary Switch S4) and multiplied by ten. An ideal Stop Time setting can be accomplished by trial and error, but should always allow for some coast time. Setting the Stop Time for too long of a time period can result in braking current to be applied to a stopped motor and will likely result in overload trips.

Table 14 - ON/OFF 8-Switch DIP Switch Definitions — Protection

PROTECTION Configuration Bank (0 = Switch OPEN)		Switch Number							
		#1	#2	#3	#4	#5	#6	#7	#8
Preset Protection Level ❶	Enable (default)	1							
	Disable	0							
Stall Fault, Parameter 230	Enable (default)		1						
	Disable		0						
Phase Reversal Fault, Parameter 136	Enable			1					
	Disable (default)			0					
OL Restart, Parameter 264	Enable				1				
	Disable (default)				0				
OL Enable, Parameter 230	Enable (default)					1			
	Disable					0			
Trip Class, Parameter 75	10 (default)						0	0	
	15						0	1	
	20						1	0	
	30						1	1	

❶ The Preset Production Level DIP switch allows the following Faults to be enabled (1) or disabled (0) as a group.

- Current Imbalance Fault — Parameter Number: 110 [default value: 15]
- Voltage Unbalance Fault — Parameter Number: 106 [default value: 15]
- Line Loss Fault — Parameter Number: NA
- Open Gate Fault — Parameter Number: NA
- No/Open Load Fault — Parameter Number: N

The PCM configuration setting for each of these Faults follows the currently entered/loaded parameter value for each Fault. This will typically be the default setting unless a 20-HIM-A6 or other configuration tool (e.g., PC software or network device) is used to change a parameter setting. The switch setting also overrides the Motor Fault Enable, Parameter 230, and Starter Fault Enable, Parameter 136, function to enable or disable these Faults.

Note that with the Preset Protection Level switch set to Disable, all Starter and Motor Faults are disabled (as defaults except the Power Quality Fault).

Table 15 - ON/OFF 8-Switch DIP Switch Definitions — I/O

I/O Configuration ❶ Bank (0 = Switch OPEN)		Switch Number							
		#1	#2	#3	#4	#5	#6	#7	#8
Aux #1 Configuration Parameter 172	Normal (default)	0	0						
	Up-to-Speed (UTS)	0	1						
	Fault	1	0						
	Alarm	1	1						
Aux #2 Configuration Parameter 176	Normal			0	0				
	UTS			0	1				
	Fault			1	0				
	Alarm			1	1				
Input #1 Parameter 56	Start/Coast (default)					0			
	Start/Stop Option					1			
Input #2 Parameter 57	Stop Option (default)						0	0	
	Clear Fault						0	1	
	Slow Speed						1	0	
	Fault						1	1	

❶ The I/O Configuration ability of the Cat. No. 150-SM6 is limited to the Control Module's standard I/O.

Parameter Configuration using a 20-HIM-A6 (FRN1.006 or later)

All of the SMC-50 parameters can be configured using the 20-HIM-A6 (NEMA Type 1) or the 20-HIM-C6S (remote-mount NEMA Type 4X/12) module. The Cat. No. 20-HIM-A6 module is normally installed in the HIM bezel/port located in the upper right corner of the SMC-50 (See Figure 12). For temporary hand-held operation, the HIM can be plugged into DPI Port #2, which is located at the top of the control module. A Cat. No. 20-HIM-H10 cable is required for this temporary operation.

The following text describes basic screen and keypad functions of the Cat. No. 20-HIM-A6 module. For additional detail on the installation and use of the 20-HIM-A6 or the 20-HIM-C6S modules, see the user manual, publication 20HIM-UM001.

HIM Single-Function Keys

The four single-function keys only perform their dedicated functions no matter which screen or data entry mode is being used.

Figure 23 - HIM Single-Function Keys

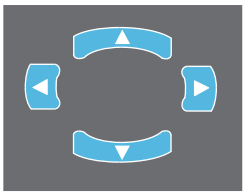
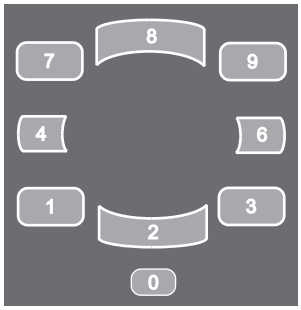
Key	Function
Start	Starts the controller if the SMC-50 Logic Mask is enabled for the port the HIM is connected to. ❶
Folders	Accesses folders for parameters, diagnostics, memory functions, preferences, and other tests.
Controls	Accesses jog, direction, auto/manual, and other control functions.
Stop	Stops the SMC-50 or clears a fault. The Stop key is always active.

❶ If the device (port) is enabled and removed under power **or** an expansion device is removed, a fault is generated. The bit location (e.g., 0, 1, 2, etc.) corresponds to the DPI port numbers.

HIM Soft Keys

Up to five dynamic soft keys can be shown at the bottom of the HIM screen. Based on the specific screen or the data entry mode being used, a soft key name and its function may change. When a soft key is active, its presentation function and corresponding soft key label are shown at the bottom of the HIM screen.

Table 16 - HIM Soft Key Functions

Soft Key	Description	Function
	Multi-Function — Blue	• Scrolls through menus and screens as directed by each arrow • Performs corresponding functions displayed in the data area
	Numeric Keys — Grey	• Enters their respective numeric values
	5/Enter	• Enters the numeric value, 5 • Displays the next level of a selected menu item • Enters new values • Performs intended actions

Basic Parameter Access & Category/File Structure

Parameter Access

The parameters of the SMC-50 are structured into five categories:

1. Monitoring
2. Setup
3. Motor Protection
4. Communications
5. Utility

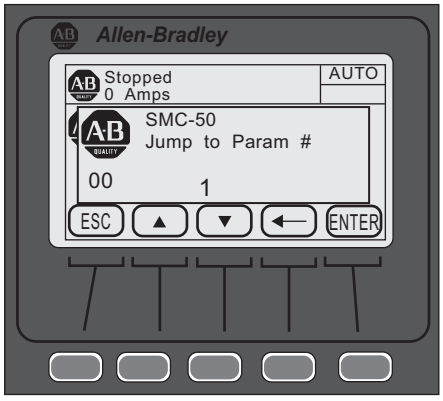
The Cat. No. 20-HIM-A6 can access any or all of the parameters that reside in any category. The following examples show how to access the SMC-50 parameters using the 20-HIM-A6.

EXAMPLE To perform a parameter number search and modification, perform the following procedure.

1. Ensure that the HIM SMC-50 power-up screen appears as shown:

2. Using the PAR# soft key, type the desired parameter number to display, then press ENTER, then press EDIT. The following screen appears.

NOTE: To access the next/previous PAR# from the one currently displayed, use the UP/DOWN arrow soft keys to display the desired parameter for modification.

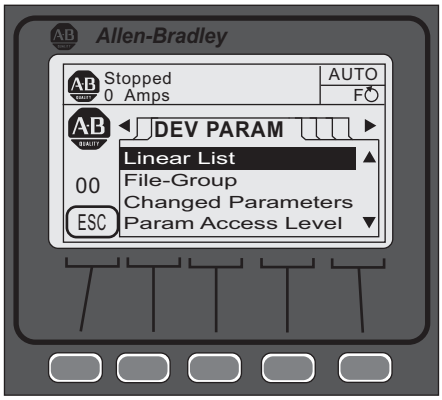


3. Press ENTER to load the changed value into memory.

NOTE: For a complete Parameter Linear list, see the user manual, publication 150-UM011.

EXAMPLE

1. From the HIM power-up screen, press the FOLDERS single-function key.
2. Press the LEFT or RIGHT arrow key until the screen displays DEVPARAM.



3. Using the DOWN arrow key, scroll to the File-Group selection. Press ENTER (keypad #5). The screen will display Port 00 Param File — Group at the top of the screen.
4. Using the DOWN arrow key, scroll to the Set Up selection. Press ENTER. The screen will display the Set Up categories (e.g., Basic, Starter, etc.).
5. With Basic highlighted on the screen, press ENTER.
6. Scroll to the desired parameter (e.g., Line Voltage) to modify it, then press ENTER.
7. Press EDIT, enter the desired value, then press ENTER to save the value.
8. Press the ESC key to return to the Basic category.
9. To modify another parameter in the Basic category, follow step 5 through step 7. To back out to a higher level category, press the BACK arrow key.

NOTE: By using the Device Parameter, DEV PARAM, folder screen and the File-Group selection SMC-50 parameters can be selected and configured by functional category. See the SMC Category/File Structure Parameters in Table 17 through Table 18.

For additional details on these procedures, see the 20-HIM-A6 or 20-HIM-C6S module User Manual, 20HIM-UM001.

Category/File Structure

Table 17 - Category/File Structure of the SMC-50 Controller.

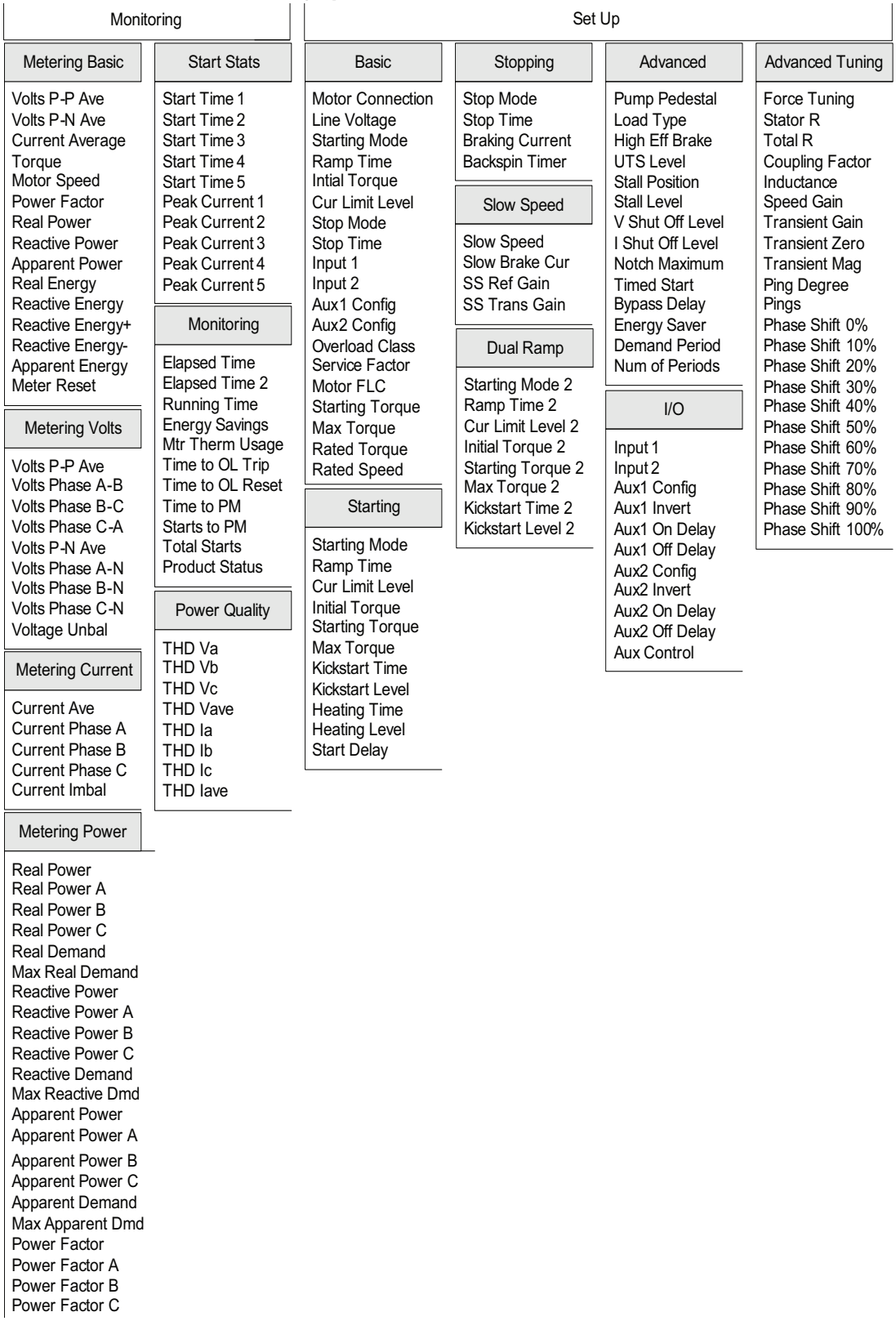
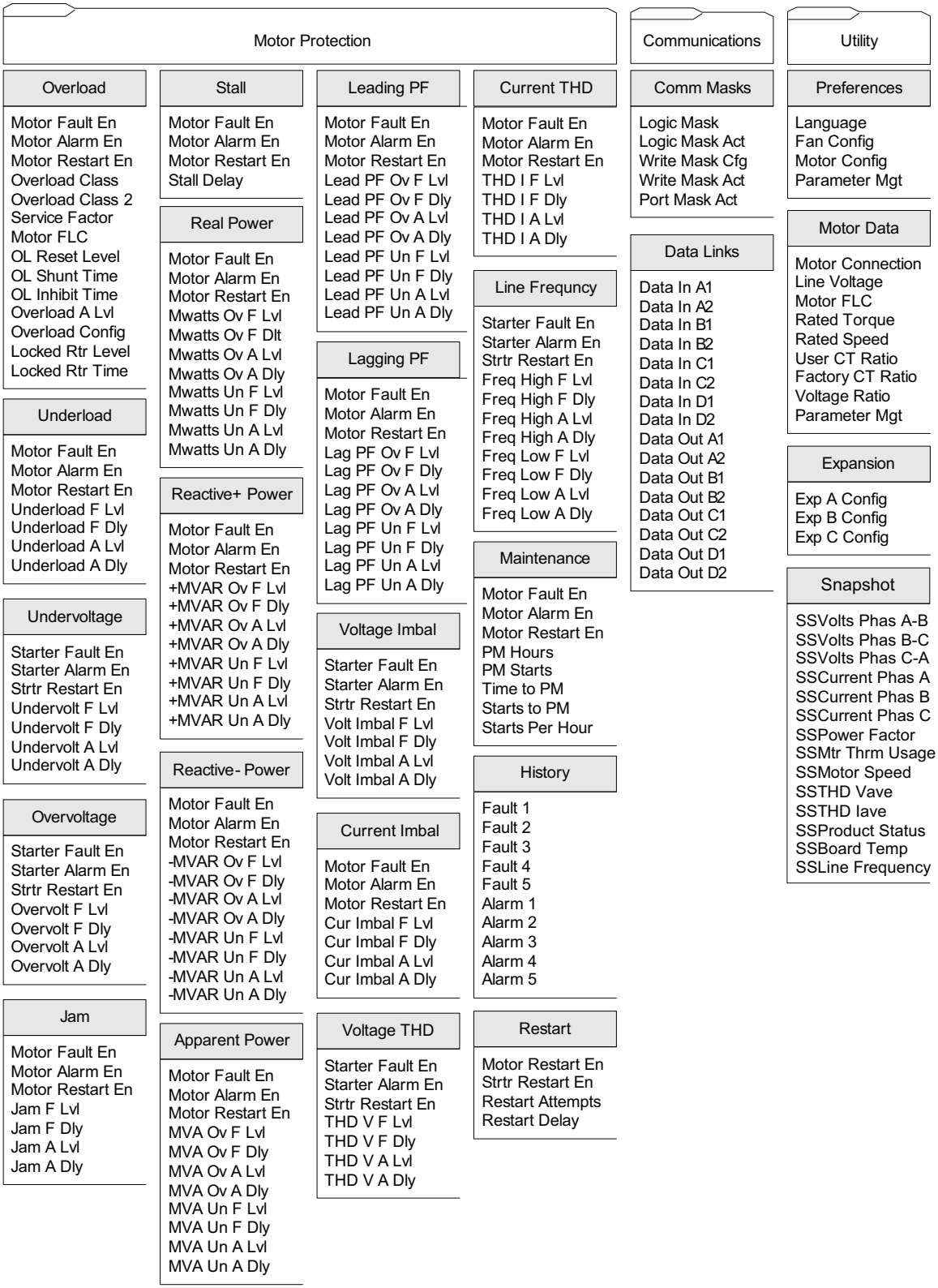


Table 18 - Category/File Structure (continued)



Quick Setup

Access the basic programming configuration group in the Setup category. This group provides a limited parameter set, allowing quick startup with minimal adjustments.

Table 19 - Quick Start Parameters

Parameter Number	Parameter Name	Description/Function	Value(s)	Default
46	Line Voltage	Enter the system 3-phase line voltage value. A value must be entered for the voltage protection functions to work properly.	0…700V	480
47	Rated Torque	Use for Torque Ramp Rating Starting Mode. Enter the maximum motor rated in Newton meters.	1…1000 N•m	10
48	Rated Speed	Use for Torque Ramp Rating Starting Mode. Enter the rated speed of the motor.	750, 900, 1500, 1800, 3500, 3600 RPM	1800
49	Starting Mode	Enter the desired starting mode for the application. ***Related Parameters for the Starting Mode:*** *Full Voltage:* None *Current Limit:* Current Limit Level, Ramp Time, Kickstart Time, Kickstart Level *Soft Start:* Initial Torque, Ramp Time, Current Limit, Kickstart Time, Kickstart Level *Linear Speed:* Initial Torque, Ramp Time, Current Limit *Torque Ramp:* Starting Torque, Maximum Torque, Ramp Time, Current Limit, Kickstart Time, Kickstart Level *Pump Start:* Initial Torque, Ramp Time	Full Voltage, Current Limit, Soft Start, Linear Speed, Torque Ramp, Pump Start	Soft Start
50	Ramp Time	Enter the amount of time desired for the motor starting ramp to take.	0.0 - 1000 seconds	10
51	Initial Torque	Motor torque level at which the start ramp begins.	0...90%LRT	70
52	Maximum Torque	Use the Torque Ramp Starting mode. Enter the maximum motor torque at the end of the start ramp required for the application.	0…300%	250
53	Current Limit Level	Enter the value of the maximum current allowed during the ramp time.	50-600% FLC	350
56	Input 1	Allows the selection of how input 1 (CM terminal #11) effects the function of the SMC-50 controller.	Disable, Start, Coast, Stop Option, Start/Coast, Start/Stop, Slow Speed, Dual Ramp, OL Select, Fault, Fault NC, Clear Fault, Emergency Run, Motor Heater	Start/Coast
57	Input 2	Allows the selection of how input 2 (CM terminal #10) effects the function of the SMC-50 controller.		Disable
65	Stop Mode	Enter the desired stopping mode for the application. Related Parameters to the Stopping Mode: *Coast:* None *Soft Stop:* Stop Time *Linear Speed:* Stop Time, Current Limit *Pump Stop:* Stop Time *SMB:* Braking Current *Ext. Brake:* Stop Time	Coast, Soft Stop, Linear Speed, Pump Stop, SMB, Ext. Brake	Coast
66	Stop Time	Defines the time desired to ramp form run to stop for a specific stop mode. For Ext Brake mode, the Stop Time = the time the Aux contact is closed to energize an external brake.	0…999 seconds	0
75	Overload Class	Enter the desired motor overload trip class.	5…30	10
77	Service Factor	Enter the Service Factor of the motor.	0.01…1.99	1.15
78	Motor FLC	Enter the motor specified Full Load Current (FLC) value. This value must be entered to ensure the controller can provide proper motor current (e.g. - Overload) protection.	1.0…2200.0 A	1.0
172	Aux1 Configuration	Allows selection of the operation for Auxiliary relay output contact #1 (control module terminals #4 and #5). ❶	Normal, UTS, Fault, Alarm, External Bypass, External Brake, Auxiliary Control, Network 1, Network 2, Network 3, Network 4.	Normal
176	Aux 2 Configuration	Allows selection of the operation for Auxiliary relay output contact #1 (control module terminals #6 and #7). ❶		Normal

❶ Normal = The contact is closed when the Start command is initiated and remains closed during a stop maneuver. After the stop is complete, the contact opens.

Operation and Troubleshooting

Operation

The SMC-50 can operate standard squirrel-cage induction motors rated 30...520 A or star-delta (wye-delta) type motors rated 52...900 A operated inside-the-delta.

IMPORTANT Verify line and control as the voltage values on the product before applying power.

Motor Configuration

Line-connected wye, line-connected delta, and inside-the-delta motor configurations are possible with the SMC-50. The motor tuning feature of the SMC-50 will automatically determine the motor connection. Motor tuning is done automatically by the controller on initial motor start or forced to occur by the user. The user can also enter the configuration of the Motor Connection, Parameter 44, into the SMC-50. The Motor Line Voltage rating, Parameter 46, must be entered into the controller by the user to enable the motor protection features to function (default 480V).

Motor Tuning

The SMC-50 will perform the motor tuning process on the initial start sequence of the motor. Motor tuning includes the identification of the motor parameters and the detection of the motor connection type (Line or Delta). The SMC-50 uses the motor tuning data in its control algorithm.

During the tuning process the motor will not turn and will make some audible noise including pulsing and buzzing. The time to complete the tuning process is approximately 10 to 20 seconds but may vary based on the size and characteristics of the individual motor being used. After successful completion of the tuning process the motor will start based on the user programmed start profile. If the tuning process is interrupted by the user giving a stop command or removing power from the unit the tuning process will be repeated on the next start command. Subsequent starts of the motor after a successful tuning will not perform the tuning process.

After the initial successful tuning of the motor the process may be re-initiated by the user via one of the following methods:

1. Change the status of the Force Tuning, Parameter 194, to TRUE by using a configuration tool (e.g., a HIM) with the motor stopped. During the next start cycle, the tuning process will occur and Parameter 194 will change back to FALSE.

2. Press the "HOLD TO TEST / PUSH TO RESET" push button, located on the front of the controller, for ten seconds with the motor stopped. During the next start cycle, the tuning process will occur. The controller's status LED will flash amber indicating that Tuning will occur on the next start cycle.
3. When the controller processes a "Load Factory Defaults" command via Parameter Management, Parameter 229.

NOTE: If a motor that is smaller or larger than normal is used for initial system test, a motor tuning cycle must be performed on the motor used in the final installation.

Troubleshooting with Diagnostic LEDs

Controller LED Status Indicator

The SMC-50 controller's multi-color LED Status Indicator and HOLD TO TEST, PUSH TO RESET button are located below the HIM bezel port. The Status LED indicates the status and fault conditions of the SMC-50 controller.

Table 20 - Corresponding LED Color and Fault Conditions

Status LED Color	Device Mode	SMC Status
Green	Running	Running without an alarm
Green/Amber	Running	Running with an alarm
Green Flashing	Ready	Ready (no inhibit and no fault) without an alarm
Amber Flashing	Ready	Ready (no inhibit and no fault) with tuning enabled on the next start
Amber	Ready	Ready with alarm (no tuning enabled)
Red/Amber	Inhibit	Inhibited; cannot start due to a Stop command
Red	Faulted	A non-resettable fault has occurred
Red Flashing	Faulted	A resettable fault has occurred
Red/Green	Download	Firmware is being downloaded

The HOLD TO TEST, PUSH TO RESET button provides the ability to reset an alarm/fault, test for a fault condition, and initiate the tuning mode.

Table 21 - Function Initiation of the HOLD TO TEST, PUSH TO RESET Button

Function	Time Required to Press Button
Fault Reset	Momentary (less than 2 seconds)
Test Fault	Greater than 3 seconds, but less than 10 seconds
Initiate Tuning Mode	Greater than 10 seconds ❶

❶ The motor must be stopped.

Using the Controller Status LED & Parameter Configuration Module (Cat. No. 150-SM6) LEDs

When a Cat. No. 150-SM6 module is installed in one of the three control module ports (7, 8, or 9) of the SMC-50 controller, additional LED diagnostic information is provided beyond that of the Status LED.

The Cat. No. 150-SM6 module has four diagnostic/status LEDs to display an LED code for each fault/alarm. When the SMC-50 controller's Status LED indicates the control module has faulted, the Cat. No. 150-SM6 module displays a specific fault code. If the unit is not faulted but in an alarm condition, the Cat. No. 150-SM6 module displays the alarm code. If the unit is neither faulted or in an alarm condition, all 150-SM6 module LEDs will not be illuminated.

The Cat. No. 150-SM6 module > (<) LED indicates whether the fault/alarm is a SMC-50 controller device fault/alarm or a motor fault/alarm. The on/off status of the other three LEDs indicate the actual fault/alarm codes.

Depending on which SMC-50 controller port the Cat. No. 150-SM6 module is installed into, the position of the LEDs (e.g., >, III, II, and I versus I, II, III, and <) change. The table below displays the LED order when the Cat. No. 150-SM6 module is installed in port 7. When the Cat. No. 150-SM6 module is installed in port 8 or 9, the order is reversed, but the LED diagnostic code is the same.

Table 22 - LED Order When Cat. No. 150-SM6 module is Installed in Port 7 of the SMC-50

	LED On/Off State			
LED Error Code	>	III	II	I
0	Red = SMC Yellow = Motor Off = No Fault or Alarm	Off	Off	Off
1		Off	Off	On
2		Off	On	Off
3		Off	On	On
4		On	Off	Off
5		On	Off	On
6		On	On	Off
7		On	On	On

The displayed LED error code is either a fault or an alarm source. For example, if the LED code is 1, Line Loss or Shorted SCR is either the fault or alarm. If a more detailed display of the error code source is desired, a human interface module (HIM) or configuration software is recommended.

The following table provides a list of fault and LED fault/alarm codes for the SMC-50 controller and Cat. No. 150-SM6 Parameter Configuration Module.

Table 23 - LED Error Code with Respective Fault/Alarm Source

LED Error Code	Fault/Alarm Source		Referenced HIM/ Configuration Software Code ❶	LED Error Code	Fault/Alarm Source		Referenced HIM/ Configuration Software Code ❶
Red = SMC							
1	Line Loss	A	1	**5**	HAL ID		33
		B	2		NVS Error		34
		C	3		V24 Recovery		35
	Shorted SCR	A	4		V24 Loss		36
		B	5		V Control Loss		37
		C	6		RTC Battery Low		69
2	Open Gate	A	7		System Faults		100-199
		B	8	**6**	Terminal Block Input	1	38
		C	9			2	39
3	SCR Overtemp		10			3	40
	Pwr Pole PTC		60			4	41
4	CT Loss	A	30		Test Fault		62
		B	31	**7**	Open Bypass	A	11
		C	32			B	12
						C	13
Yellow = Motor							
2	No Load		14	**4**	Overload		21
	Open Load	A	15	**5**	Stall		24
		B	16	**6**	Phase Reversal		25
		C	17	**7**	Current Imbalance		42
3	Volt Imbalance		18				

❶ The Fault/Alarm code, available from a HIM or configuration software, provides more detailed information concerning the source of the fault/alarm. Fault and alarm codes for the same event (e.g., Line Loss) are the same.

Troubleshooting with Monitoring Equipment

The SMC-50 controller has built-in detailed diagnostics fault codes and metering functions. These fault codes and metering functions can be accessed through a local 20-HIM-A6 or remote 20-HIM-C6S module or by using a Rockwell Automation Drive Software package such as Connected Component Workbench.

Troubleshooting By Fault Code — Abbreviated Listing

The following table contains an abbreviated listing of fault codes available. For a complete troubleshooting list, fault codes, and tips, See the SMC-50 User Manual.

Table 24 - SMC-50 Controller Fault Codes

Display Fault	HIM or Software Fault Code	Enabled	Possible Causes	Possible Solutions
Line Fault with Phase Indication	1, 2, 3	Prestart and Running	• Missing supply phase • Motor not connected properly • Incoming 3-phase voltage instability	• Check for open line (i.e. blown fuse) • Check for open load lead • Verify power quality
Shorted SCR with Phase Indication	4, 5, 6	All	• Shorted power module	• Check for shorted SCR, replace power module if necessary
Open Gate with Phase Indication	7, 8, 9	Start or Stop	• Open gate circuitry • Loose gate lead	• Perform resistance check; replace power module if necessary • Check gate lead connections to the control module
PTC Power Pole and SCR Overtemp	10 or 60		• Controller ventilation blocked • Controller duty cycle exceeded • Fan failure • Ambient temperature limit exceeded • Failed thermistor	• Check for proper ventilation • Check application duty cycle • Wait for motor to cool or provide external cooling • Replace power module or control module as needed • Replace fan
Motor PTC	59	Running	• Motor ventilation blocked • Motor duty cycle exceeded • PTC open or shorted	• Check for proper ventilation • Check application duty cycle • Wait for motor to cool or provide external cooling then check resistance of PTC
No Load Fault	14, 15, 16, 17	Prestart Only	• Loss of load side power wiring with phase indication (15=A, 17=C) • Start command cycled unexpectedly with motor rotating	• Check all load side power connections • Check motor windings
Voltage Unbalance and/ or Current Imbalance	18 and/or 42	Running	• Supply unbalance is greater than the user-programmed value • The delay time is too short for the application	• Check power system and correct if necessary, then correct the user-programmed value • Extend the delay time to match the application requirements
Overvoltage	19	Running	• Supply voltage is greater than the user-programmed value • The delay time is too short for the application	• Check power system and correct if necessary, otherwise correct the user-programmed value • Extend the delay time to match the application requirements
Undervoltage	20	Running	• Supply voltage is less than the user-programmed value • The delay time is too short for the application	• Check power system and correct if necessary, otherwise correct the user-programmed value • Extend the delay time to match the application requirements
Overload	21	Running	• Motor overloaded • Overload parameters are not matched to the motor	• Check motor overload condition • Check values for overload class and motor FLC and verify current draw of the motor
Underload	22	Running	• Broken motor shaft, belts, tool bits, etc. • Pump cavitation • Incorrect user setting	• Check pump system, machine drive components, and loading • Check settings • Repair or replace motor
Jam	23	Running	• Motor current has exceeded the user-programmed jam level	• Correct source of jam or excessive loading and check programmed time value
Stall	24	Running	• Motor did not reach full speed by the end of the programmed ramp time • Incorrect user setting	• Check pump system, machine drive components, and loading. Repair or replace motor, if necessary. • Check settings
Phase Reversal	25	Prestart only	• Incoming supply voltage is not the expected ABC sequence	• Check power wiring and correct if necessary

Display Fault	HIM or Software Fault Code	Enabled	Possible Causes	Possible Solutions
Network and Comm's Loss	See Port Number of Fault (See Table 25)	All	• DPI network loss • Communication disconnect at the serial port	• Check communication adapters and verify connection to the SMC. • Reconnect each DPI connected device
Ground Fault	58	Running	• Ground fault current level has exceeded programmed value • The delay time is too short for the application	• Check power system and motor; correct if necessary. Check programmed ground fault levels to match application requirements • Extend the delay time to match the application requirements
Line Power Quality with Phase Indication	52, 53, 54	Start or Stop	• Incoming 3-phase voltage instability or distortion • High impedance connection	• Check supply voltage for capability to start/stop motor; check for loose connections on the line side or motor side of the power wires • Verify and correct the input power quality
Internal 24V and System Faults	36, 37	All	• Low line condition • Excessive load on internal 24V supply	• Check the control power and verify it is within the specification; check the connections and grounding to the SMC control terminals • Replace the control module

Table 25 - Port Assignment

Port Number	Source
0	Control Module
1	HIM Located in Controller Bezel (optional)
2 or 3	Remote DPI
4	20-COMM-X (optional)
7, 8, 9	Expansion Port 7, 8, 9 (option module)

SCCR Ratings

SCCR Ratings

Table 26 - SCCR (High Capacity Fault) Electrical Ratings

Type 1 Coordination ❶								
SCPD Performance ❷		**Class J or Class L Fuse ❸**			**Inverse Time (Thermal Magnetic) Circuit Breaker ❹**			
SCCR List (High Capacity Fault)		**Maximum Available Fault (600V) [kA]**	**Amps**		**480V, 65kA Maximum**			
			Typical	**Max.**	**Bul. 140U Frame Size ❺**	**Max. Amps**	**Cat. No. ❺**	**Rating Plug**
Line Device Operational Current Rating [A]	90	100	150	200	M	350	140U-M6D3-D35	not required
	110		175	225		300	140U-M6D3-D30	not required
	140		225	300		400	140U-M6D3-D40	not required
	180		300	400		400	140U-M6D3-D40	not required
	210		350	450	M	600	140U-M6D3-D60	not required
	260		450	500		700	140U-M6D3-D70	not required
	320		500	700		800	140U-M6D3-D80	not required
	361		601	800	N	1000	140U-N6L3-E12	140U-NRP3-E10
	420		700	800		1200	140U-N6L3-E12	140U-NRP3-E12
	520		800	1000		1200	140U-N6L3-E12	140U-NRP3-E12
Delta Device Operational Current Rating [A]	155	65	250	300	M	450	140U-M6D3-D45	not required
	190		300	400		500	140U-M6D3-D50	not required
	242		400	500		700	140U-M6D3-D70	not required
	311		500	600		700	140U-M6D3-D70	not required
	363		601	800	N	1000	140U-N6L3-E12	140U-NRP3-E10
	450		700	1000		1200	140U-N6L3-E12	140U-NRP3-E12
	554		800	1200		1200	140U-N6L3-E12	140U-NRP3-E12
	625		1000	1200	R	1600	140U-R6L3-E20	140U-R20RP3-E16
	727		1200	1600		2000	140U-R6L3-E20	140U-R20RP3-E20
	900		1200	2000		2000	140U-R6L3-E20	140U-R20RP3-E20

❶ **Basic Requirements for Type 1 Coordination:** Under the short-circuit condition, the starter shall cause no danger to persons or the installation. The starter may not be suitable for further service without repair or replacement of parts. For further details, See UL508/CSA C22.2 No. 14 and EN 60947-4-2.

❷ Consult local codes for proper sizing of short-circuit protection.

❸ High capacity fault ratings when used with a time delay Class J fuse or time delay Class L fuse.

❹ Circuit Breaker must be of the designated 140U Frame

❺ Other circuit breakers pending.

Notes:

Repair/Replacement Parts

Control Module

Description	SMC Rating	Voltage Rating	Cat. No.
Standard	All	For controllers rated 200...480V AC and 200... 690V AC (120/240V AC control power)	150-SCMD
Standard	All	For controllers rated 200...480V AC and 200... 690V AC (24V DC control power)	150-SCMR

Power Poles

Controller Cat. No.	Series	Catalog Number			
		200…480V		200…690V	
		120V/240V AC Control	24V DC Control	120V/240V AC Control	24V DC Control
150-SB1…	A	150-SPPB1B	150-SPPB1BR	150-SPPB1U	150-SPPB1UR
150-SB2…		150-SPPB2B	150-SPPB2BR	150-SPPB2U	150-SPPB2UR
150-SB3…		150-SPPB3B	150-SPPB3BR	150-SPPB3U	150-SPPB3UR
150-SB4…		150-SPPB4B	150-SPPB4BR	150-SPPB4U	150-SPPB4UR
150-SC1…	A	150-SPPC1B		150-SPPC1U	
150-SC2…		150-SPPC2B		150-SPPC2U	
150-SC3…		150-SPPC3B		150-SPPC3U	
150-SD1…	A	150-SPPD1B		150-SPPD1U	
150-SD2…		150-SPPD2B		150-SPPD2U	
150-SD3…		150-SPPD3B		150-SPPD3U	

Heatsink Fans

Controller Cat. No.	Series	Catalog Number	
		120V/240V AC Control	24V DC Control
150-SB…	A	150-SF1	150-SF1R
150-SC…		150-SF2D	150-SF2R
150-SD…		150-SF3D	150-SF3R

Other Components

Component	Description		Catalog Number
Option Modules	PTC, ground fault, current feedback		150-SM2
	Analog I/O module, 2 inputs/2 outputs		150-SM3
	Digital I/O, four 120/240V AC inputs, three relay outputs		150-SM4
	Parameter Configuration — DIP & rotary dial		150-SM6
Replacement Control Wiring Terminal Blocks (module as shipped includes terminal block)	Control Wiring Terminal Block for:	Control module	150-SCMRTB
		PTC, ground fault, current feedback module	150-SM2RTB
		Analog I/O module	150-SM3RTB
		Digital I/O module	150-SM4RTB
Line/Load Surge Protective Module ❶	480V AC, 90 A and greater		150-F84L
	600V AC, 90 A and greater		150-F86L
IEC Terminal Cover	IEC line and/or load terminal cover for 90...180 A devices, dead front protection, (IP2X (finger safe) with 250MCM wire)		150-STCB
Control Module Cover	Replacement control module front cover		150-SCMRC
Controller Cover	Replacement controller cover for 210…320 A units		150-SCRC
	Replacement controller cover for 361…520 A units		150-SDRC
Fan Cover	Replacement fan cover for 90…180 A units		150-SBFC
	Replacement fan cover for 210…320 A units		150-SCFC
	Replacement fan cover for 361…520 A units		150-SDFC

❶ To protect the Smart Motor Controller (SMC) and/or motor from line voltage surges, protective modules may be placed on the line, load, or both sides of the SMC. **Do not place protective modules on the load side of the SMC** when using an inside-the-delta motor connection or with pump, linear deceleration, or braking control.

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at https://rockwellautomation.custhelp.com/ for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

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